Selected Papers in School Finance 1975

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The three papers contained in this volume comprise exploratory efforts to adjust State aid to local school districts so as to reflect differences in local costs unrelated to school program content. Each study was limited to an analysis of relevant data for one State, namely Michigan, California, and Florida. The underlying assumption of these studies is that one dollar in State aid or other revenues does not purchase the same amount of educational service throughout a State because of differences in local prices paid. The problem addressed in these studies is: Can States adjust education aid for local cost differences? Whether States should adjust their aid to reflect such differences is a policy matter upon which these studies shed some light. In a sense, the authors were pioneers, exploring the possibility of applying econometric techniques to derive indices of local cost adjustments for the distribution of State school aid. Inevitably, the resulting studies are technical, as they center around theoretical and statistical analyses for selecting the most reliable variables for which data are available and which are associated with interdistrict differences, primarily in teacher salaries and secondarily in other educational costs.

The central question of these studies is what features of school districts account for differences in the prices paid for the goods and services they purchase. Since the most important purchase of school districts is teacher services, the studies emphasize features which determine differences in the

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salaries paid for these services. Essentially, the problem is to select variables which account for differences in salaries paid for teachers of like quality in various districts. Do some districts pay more for teachers because they can afford to do so or because features of their school systems require them to pay more for the same quality teachers? With the aid of econometric analysis the authors have attempted to sort out the features of a school system reflecting a district's ability and willingness to pay more for teachers from features which require it to pay more to attract a sufficient number of "quality" teachers. District ability and willingness to pay more reflect district demand variables and district characteristics requiring that salary differentials be paid are teacher supply variables. The underlying assumption is that State aid should be adjusted only for district features affecting the supply of teachers; otherwise, State aid would flow to those districts with the willingness or ability to pay more.

In pursuing their independent studies, the authors have identified some major problems stemming from the methodology imposed by statistical analysis and from the limitations of the data. Some of these problems are discussed below.

One problem confronting the authors is to determine which district features are supply-related variables and which features are demand related. For example, does a higher than average per pupil tax base indicate an ability to pay more for "quality" teachers (a demand variable) or does the higher tax base indicate an area with higher living costs which affect teacher willingness to work there (a supply related variable)? Brazer and Grubb treat the tax base as demand related; Kenny and his colleagues believe the tax base influences the supply price of teachers.

Agreement among analysts on how variables should be interpreted may not always be possible because of major differences in institutional features among the States. For example, Florida's school districts are countywide so that the disparities in district wealth bases are probably less pronounced there than in the other two States. There are 67 school districts in Florida, 1,037 in California and 580 in Michigan. The level of State support for public schools is substantially higher in Florida, so that a district's willingness or ability to pay more would carry less weight there than in the other two States. State aid, on the average, comprises 60 percent of State/local public school outlays in Florida, 45 percent in California and almost 40 percent in Michigan. It is likely that such State differences have influenced the authors' perception of district features and how to treat them in their analyses.

Another problem highlighed by these studies has to do with the amount of variation in prices paid which can be traced to features or variables included in the analyses, i.e., the explained variance. At most, only 70 percent of the variation in teachers salaries among districts can be explained by such analyses. Brazer assumes that the unexplained variance is not correlated with any district features we may wish to include in any State aid adjustment. Others may conclude that the existence of so much unexplained variance renders statistical techniques useless in resolving the central problem. In general, social scientists would view explained variance of such a magnitude as quite satisfactory.

What role should teacher quality play in analyses of local cost differences? This is another problem confronting the authors and on which they diverge markedly. Brazer maintains that once a wage scale has been set and teachers are hired, the quality measures available -- i.e., degree status and years of experience -- are irrelevant to the statistical analysis of costs. Grubb concludes on the basis of the California data that teacher degree status and experience are not valued by school districts, and that teaching staffs reflect other features sought by districts and are not captured in these analyses. Kenny et al. state that teacher degree status and experience are the only teacher quality measures for which districts pay salary differentials. Such divergences cannot be explained away by institutional features of the three States for which data were analyzed. Rather, they reflect a fundamental difference which remains unresolved.

These studies demonstrate both the possibilities and limitations of statistical analysis as a means of estimating appropriate adjustments designed to neutralize local cost differences for State aid purposes. The authors identify problem areas requiring attention in their papers. Grubb suggests further studies relating to teacher hiring decisions. Kenny suggests that the model be tried in other States both to test its validity and to refine it further. Clearly the problem of whether to adjust State aid for local cost differences is both a question of policy and of techniques. Policy makers must decide whether State aid should be adjusted for local cost differences, and if so, what is the best procedure for undertaking such adjustments. For researchers, much pertinent analyses remain to be undertaken. The papers contained herein provide a solid

for pursuing further studies. What follows is a brief summary of

The paper by Prof. Brazer and Dr. Anderson, "A Cost Adjustment Index for Michigan School Districts," is a follow-up study to the previous paper published in Selected Papers in School Finance, 1974. In this paper, Brazer again utilizes multiple regression analyses to measure the influence of selected factors on local price differences for educational services, or local costs for school districts. However, in this new study the list of variables was expanded to include all of the apparently relevant factors for which data were available in the sample school districts. The study is divided into two parts. In the first, factors which affect instructional costs are analyzed and in the second part, non-instructional cost differences are studied.

Since teachers' salaries are the major component of local instructional costs, much of the analysis focuses on those features of school districts which affect the level of teachers' salaries. Brazer sorts the features affecting district teacher salary levels, into three groups; the first group of features or variables reflect a district's preference for public school expenditures; the second group reflect a district's ability to pay for teachers; and the third group of factors reflect conditions of a school district which may influence the willingness of teachers to work there.

The first two groups of factors, the preference for public schools and the ability to pay for them, affect a district's demand for public education services. An example of a district's willingness to support schools may be reflected by the number of persons living in a district who attended college and who may be assumed to view education as a desirable public good. Another example is the

proportion of pupils of a district's population who attend public schools. The assumption is that as the number of public school students rises as a proportion of the district's population, the more willing a district is to support public education. Among the features most commonly associated with a district's ability to pay for public schools is, of course, the property base per pupil. Another factor may be the proportion of families living in a district with incomes over $15,000.

Brazer makes it abundantly clear that State aid to a school district should not reflect adjustments based on a district's willingness or ability to pay higher salaries for teachers. To do so, would transfer to the State burdens of instructional costs which quite properly belong to the districts. This is to say, more State aid would flow to districts which were employing relatively more teachers or paying better than average salaries because they could easily afford to do so or because they preferred a "better" educational service or better "quality" teachers.

Since it is unclear as to what "quality" teachers are or what measures are relevant to teacher quality, Brazer excludes considerations of quality in this analysis. He says, "Ideally, we should have an index of teacher quality, but once a salary scale is established, it is not at all clear that quality matters."

Any State aid adjustments to school districts relating to cost must be based on those district features or attributes which affect the willingness of teachers to work there i.e. those variables which have an impact on the supply of teachers to a district. It is these features which are incorporated in the supply prices of teachers i.e. salaries required to attract the desired number of "quality" teachers.

To begin with, districts must pay more for teachers with more years of experience and with advanced degrees or who have accumulated post-graduate credit hours. Since these factors are normally built into teacher salary schedules, their influence on teacher salaries comes as no surprise. Brazer's model also shows that as district enrollment increases and with increased population density the amount that districts pay for teacher salaries also rises. The two factors probably reinforce each other as they are likely to occur in the same districts. Other factors which appear to exert some upward influence on teachers' salaries are the proportion that males comprise of the teaching force of any school district and the average annual earnings of employed males in the county in which any district is located and which approximates the opportunity cost for teachers.

Contrary to conventional expectations, some significant factors appear to have no discernible influence on teachers' salaries in the Brazer study. The percent of population that is non-white in any district and student achievement scores (which should bear on the amount of teaching effort required) do not appear to be independent factors exerting much upward pressure on teacher salaries. This is surprising because these are the examples commonly cited as supporting claims for "battle pay" in districts bearing these characteristics. However, it is unclear to what extent the influence of these factors may have been captured by district population size or density, which do have a bearing on salaries in Brazer's analysis.

Brazer attempts to isolate the pressure of union influence on teacher salaries by utilizing measures of union strength, namely the number of days that teachers were on strike during the three years 1970 to 1972, and the provision in a district's union contract for an agency shop and binding arbitration. All of these variables appear

to exert an upward pressure, with average salaries rising by $30 for each day that teachers were on strike during the 1970-72 period. The presence of requirements for both an agency shop and binding arbitration in a district union contract were associated with an average teacher salary rise of $362 in Michigan, or the equivalent of a twelve-day strike. Conceivably then, this amount can be viewed as a reward to teachers for not striking.

The influence of location or type of community on teacher salaries was also studied. School districts were classified in accordance with standard Census definitions as central city, suburban, independent city and rural. Brazer's analysis indicates that the type of community does not have a significant bearing on teacher salaries. What appears to be taking place is that divergent forces are neutralizing each other, so that the amenities and disadvantages of central cities, for example, do not on balance exert a greater pull on salaries than do similar considerations in suburban or rural environments.

As a result of an analysis of these and other variables mentioned in his paper, Brazer is able to account for about 70 percent of the variation in average teacher salaries among districts. This leaves a 30 percent variance unaccounted for, which is troublesome but not unusual in equations encompassing human behavior and institutional factors.

Having completed his analysis of the factors which influence the willingness of teachers to work in a school district (i.e. the supply conditions) Brazer proceeds to construct an adjustment index for teacher salaries. This index indicates to what

extent the combined effect of the actual values of those district features taken into account which do bear on teacher salaries in any district differ from the combined effect of the average values for all the sample districts.

Excluded from this index are those variables which should not be compensated for through State aid, despite their observed influence through the supply function on teacher salaries. Measures of union militancy are the most notable exclusion, for to compensate school districts on such a basis would remove local incentives to resist union demands. If they were not excluded, the increased costs resulting from successful union demands would be transferred to the State. Data reflecting the sex composition of the teaching staff are also excluded from the construction of the salary adjustment index since it is clearly discriminatory to reward districts for having more male teachers. The presence of non-white pupils in a school district is also excluded as a variable since it is poor public policy to "compensate" a district's teaching staff on such a basis.

An adjustment salary index number is constructed for each of the sample districts. These index figures appear in the text in Table 3 where they are compared with an index of the actual variation of each district's average salary from the average statewide salaries.

When school districts are classified according to Census definitions, the following differences in salary indices are observed:

Actual Average Salary Index is:	Central Cities*	Indep. Cities	Suburbs S.D	Rural S.D
a) above the adjusted teacher salary index	5	7	52	9
b) below the adjusted teacher salary index	5	16	43	21
c) virtually the same	3	1	7	

*Includes some suburbs which Brazer classified as central cities because their characteristics are closer to central cities.

If State aid were to be adjusted according to a salary index based on district features over which it had no control i.e. features affecting the supply condition or the willingness of teachers to work in a district, the following pattern emerges. All central cities would gain State aid because their adjusted salary indices are above 1.00 as reported in Table 3 in the text, but the five cities in line (a) above would gain less than their present salary levels would indicate and the five in line (b) would gain more than the actual salaries paid. The three in line (c) would gain no additional State aid if a teacher salary index adjustments were used. This is indicated by the ratio of their average salaries to the State average. Among independent cities and suburbs, no distinct pattern emerges though all districts whose index is above 1.00 in Table 3 would gain State aid. Here too, however, aid would be adjusted more or less depending on the relationship between the two indices. All but one rural district would lose State aid because their indexes are reported below 1.00 in Table 3. However, some would lose more than others depending on the relationship between the actual mean salary index to the adjusted mean salary index.

Brazer next develops an index for non-instructional expenditures using the same methodology. He adds however, that the two indices are independent of each other and that utilizing a teacher salary adjustment index does not require the use of an index for non-intructional expenditures.

W. Norton Grubb, when given the same problem of studying the applicability of adjustments in State education aid for local price differences, wrote his paper, entitled, "Constructing Teacher Cost Indices: Methodological Explorations with California Unified School Districts." Grubb states that the three factors which comprise instructional cost for any school district are: (1) salaries paid teachers of a given quality; (2) teacher quality; and (3) teacher-pupil ratio

Grubb first develops a theoretical model identifying the essential nature of the teacher supply and district demand curves for teachers but concludes that such a model is not useful because it does not enable him to isolate the teacher supply curve for any district. Reluctantly, he concludes that his only recourse is to utilize statistical analysis of reduced form equations to analyze the impact of teacher supply and demand on district wages, teacher quality, pupil-teacher ratios, and expenditures. This multiple regression analysis is the necessary first step in order to elimate cost adjustments reflecting district demand variables. Grubb's reluctance to use this methodology stems from the fact that such analyses require "strong a priori judgements about which variables tend to present supply and which represent demand." The difficulty here is "that we cannot be sure whether variables which represent wages, quality and the teacher pupil ratio . . . are demand or supply variables or some combination of the two."

Despite this reservation, Grubb proceeds to a consideration of the variables or district features which impact on the demand and supply for teachers. These variables are essentially those used by Brazer et al. such as equalized property valuation per pupil, county population density, pupil mobility etc. Grubb also analyzes the effect of intergovernmental aid on instructional costs and concludes, "Non-Title I (E.S.E.A.) Federal aid largely impact aid increases teacher expenditures as well as salary levels, teacher quality, and the teacher pupil ratio, but Title I -- although it is often insignificant -- does just the opposite." Grubb views intergovernmental aid as clearly demand-related. Like Brazer does for Michigan, Grubb also concludes that in California there is no basis for asserting that teachers receive additional pay for teaching minority and poor pupils.

The impact of these various independent variables are studied separately for each of the three major areas of instructional costs, namely, on teacher salaries, on teacher quality, and on teacher/pupil ratios and the results are reported in Tables 1 to 3 in the text. District data are readily available on teacher salaries and on teacher/pupil ratios but teacher quality measures are much more elusive. To be sure, districts have data on teacher degree status and years of teaching experience, but Grubb doubts that these are the measures which reveal the teacher qualities that districts demand or that influence the supply of teachers to any district.

What particularly concerns Grubb is the small effect that the various independent variables have on the available measures of teacher quality, i.e. on teacher degree status or graduate credit hours and years of teaching experience. He states, "The abysmally low explanatory power of these regressions indicates that variations in these measures of 'quality' are largely unexplained by any of the independent variables available . . . . It appears, therefore, that these . . . measures do not reflect teacher quality at least in the sense of measuring teacher attributes which school districts attempt to increase." But, what should also be clear is that these attributes are precisely the ones over which a school district has no control, once a teacher is hired. Teacher staffs inevitably acquire years of experience so long as they retain their positions, and individual teachers will also accumulate graduate credits if the incentives to do so exist as in the form of salary differentials attached to graduate credit hours or to degree status. [1/] Grubb suggests (in footnote number 42) that one way to investigate variations in the demand and supply of teachers is to focus on newly-hired teachers rather than on the total number of teachers employed in districts. Such investigations could shed light on what teacher quality features influence teacher salaries at the time hiring decisions are made.

Grubb views the effects of teacher quality on the demand and supply of teachers as central to his analysis. The problems are: (a) what kind of quality teachers do districts demand; and (b) what types of quality teachers are willing to work in a given district at a given wage. It is only the part (b) question which

[1/] Such salary differentials have long been standard features of school district salary schedules.

is appropriate in a cost adjustment index. Grubb now utilizes the independent variables which appear to impact on teacher supply to construct a number of cost adjustment indices which reflect different assumptions as to whether the teacher quality measures (degree status and years of experience) influence the supply of, the demand for teachers, or both. The correlation among these indices is so low that they cannot be used with any degree of confidence. He says, " . . . we can have little confidence that any particular index will 'correctly' order school districts; the possibility of serious errors in adjusting school aid is therefore larger." Again, the difficulty may stem from the quality measures themselves which may be entirely inappropriate for such an analysis.

Grubb next goes on to consider the purposes of cost adjustment. He points out that even if State aid to LEAs were adjusted for local cost differences, revenues raised locally would still reflect local cost variations. Only if these revenues are also "adjusted" could States remove the total impact of local cost differences on educational services. However, he points out that the implication of such adjustments is that they would favor districts with high costs and large amounts of local revenue - characteristics of wealthy districts - and would reduce resources to low-cost low-spending districts which are likely to be in poor rural areas.

In his concluding section, Grubb notes that statistical analysis does offer the means of calculating local cost adjustments. However, he is concerned with some of the problems associated with this methodology. As does Brazer, he notes that the independent variables account for only 70 percent of the variation in teachers salaries. And he also observes that not all of the relevant variables such as union strength may be desirable for inclusion in an index. Political decisions would be required with respect to the inclusion of variables such as a district's unemployment rate and the proportion of school age children to a district's population. In the end, Grubb emphasizes that the redistributive effects of such aid adjustments should be carefully weighted especially if the net effect is to take aid away from the poorer districts to benefit the wealthier ones.

In the paper entitled, "Measuring Differences among Florida School Districts in the Cost of Education: An Alternative Approach," Messrs. Kenny, Goffman and Denslow reported the results of their statistical analysis based on Florida data. The "alternative approach" in their title refers to the use of statistical analysis to adjust State aid for local cost differences. The current practice in Florida is to price a list of commodities and services in various parts of the State and to adjust State aid for local price differences based on the difference between the local prices and State average prices. Florida is the only State which adjusts State aid to school districts on the basis of estimates of local consumer price levels. The assumption in this study is that teachers offered the same wage in different districts do not respond solely to living costs in choosing jobs but do in fact take into account other features of school systems.

The authors of the Florida study diverge markedly from Grubb and Brazer in the variables which they believe affect the demand for and supply of teachers. In their view, district demand for teachers or willingness to pay differing teacher rates is influenced solely by the degree status and years of experience of teachers. All other variables are viewed as affecting the supply price of teachers, i.e. the wage at which teachers are willing to work in any district. As mentioned above, variables which Brazer and Grubb view as reflecting a district's ability to pay more for teachers such as higher assessed valuation per pupil or higher average income, they believe affects the cost of living in such districts and hence the supply price of teachers.

In their analysis, Kenny et al. conclude that such factors as a district's cost of living, population density, pupil test scores, and a measure of the crime rate all influence the willingness of teachers to work in school districts. As a surrogate measure for the cost of living, the authors use the price of land in any district plus the degree of urbanization of that district.

The authors confront the question of the elasticity of the teacher supply curve and reach differing conclusions as to its shape. Kenny et al. believe the supply of teachers is perfectly elastic. That is, any district can hire as many teachers as it wants as its established wage rate. District features may cause the entire supply curve to shift, but an increase in district demand for teachers will not in itself cause wages to rise. Brazer believes that once the wage level is set

through a bargaining agreement, a district may hire as many teachers as it wants at that wage. On the other hand, Grubb states that we cannot know with certaintly what the teacher supply curve looks like. Since the underlying forces which shape teacher supply influence the total wage bill as well as local tax rates and State aid in any district, the lack of concensus among the authors on the elasticity of teacher supply represents a serious methodological problem which remains unresolved.

In the Florida study, the authors compared the dollar reallocation resulting from their equations with the amount reallocated by using Brazer's equation (from his first paper). Where the list of demand variables includes all those proposed by Brazer, $18.6 million would be reallocated; where teacher experience and degree status are the only demand variables, the dollar reallocated declines to $9.0 million. This illustrates how the choice of variables and their placement in the supply or demand size of the reduced form equation leads to results which are substantially at variance.

The final section of this paper contains a critique of the present Florida price of living index. Some State aid is allocated to the wealthy districts because of the higher living costs encountered there. However, this would be true whether State aid is allocated under the present formula in Florida or under the "compensating differentials approach" developed in this study. The present

Florida index concentrates on the cost of living and ignores "location-specific amenity levels." Further, despite the efforts to avoid bias in the annual surveys of prices in Florida by controlling for quality differences, the present index "is biased upward in well-to-do counties because their stores stock better clothes and because people in them live in better houses and apartments . . ." The question arises, "Instead of trying to ascertain exactly what size apartment a block from the Atlantic is the equivalent of a three-bedroom frame house in a pecan grove, why not find out what salary differentials are required to attract teachers of a given quality to schools in the respective counties?" To be sure. what constitutes teacher quality has not been fully resolved and remains a research problem.)

This summary of the volume's papers is admittedly sketchy, avoiding many of the nuances and much of the complexities found in the studies. The aim was to provide the non-technical reader with some insights into the subject matter. For a full appreciation of the contents of these papers, a careful reading is required.

A COST ADJUSTMENT INDEX FOR MICHIGAN SCHOOL DISTRICTS

INTRODUCTION

Inequality in educational opportunity has been in the forefront of public concern for many years. That concern was heightened and intensified by judicial opinions handed down between 1971 and 1973 by state and Federal courts dealing with litigation involving the financing of elementary and secondary education in Arizona, California, Kansas, Michigan, Minnesota New Jersey, and Texas. [1]

For lack of clear-cut, direct definition of educational opportunity, litigants as well as the courts have tended to look at either expenditures per pupil or expenditures relative to tax effort. Amounts spent for educational services may be a poor index, however, of the quality or quantity of services supplied. Educational outputs, presumably, are some function of the quantity and quality of inputs, technology, and managerial efficiency applied to their production. Very little is known, however, about the "production function" in education, that is, about the relationship between the quantity and mix of inputs and the quantity of output. This is partly because the output of the public schools consists of many things, including accretions to human capital, consumer goods like baby sitting services, public goods in the form of "socialization" of children, and a screening service for colleges, employers, and others; and partly because we do not know how to measure these

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[1] For citations and discussion of the court opinions in these and other states, see "Future Directions for School Finance Reform" Law and Contemporary Problems, Vol. XXXVIII, No. 3, 1974.

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varied elements of output, let alone place dollar values on them.[1]

While recognizing that these problems exist, we shall focus on another source of differences in the relationship between expenditures on inputs and educational output. That source is differences in prices paid for inputs. These differences alone may be sufficient to account for wide disparities in the relation between educational dollars spent and educational services or opportunity supplied. Clearly if school districts pay different salaries (prices) to teachers and other personnel of like quality, as well as different prices for non-personnel inputs, then not only will the ratio of expenditures to output vary among districts, but so will the ratio of expenditures to quantity and/or quality of inputs. Obviously, therefore, expenditures per pupil are not even a good index of input per pupil.

The problems posed by differences among school districts in prices or costs of inputs, and an exploratory effort to develop a rational basis for taking these differences into account, in determining either state aid for schools or total funds available, were pursued in our earlier study.[2] This

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[1]Some would argue that the investment in human capital output of the schools is measurable and has been measured frequently. But observing that people with more years of schooling tend to earn higher incomes makes the point less than conclusively. One may legitimately suspect that a given set of characteristics that leads people to pursue more schooling is simply the same as the set that yields high incomes. For some evidence suggesting that quality as well as quantity of education counts in the accretion of human capital, see George E. Johnson and Frank P. Stafford, "Social Returns to Quantity and Quality of Schooling," Journal of Human Resources, Spring 1973.

[2]Harvey E. Brazer, assisted by Ann P. Anderson, "Adjusting for Differences Among School Districts in the Costs of Educational Inputs: A Feasibility Report," in Office of Education, U.S. Department of Health, Education and Welfare, Selected Papers in School Finance, 1974.

paper presents the product of our efforts to extend and improve upon the methodology used in the first study and to bring data on a wider range of variables into account.

If we were concerned only with measuring the differences among districts in prices paid for school inputs, the problem would be the comparatively simple one of collecting the needed data. Suppose that school inputs consist of teachers, non-teaching personnel, and "other". Let the corresponding weights for each, given by the proportion of operating budgets that it accounts for, be w_t, w_n, w_o, while the prices or average salaries paid are represented, respectively, by T, N, and O. Then the price index for any school district, i, may be obtained by dividing the weighted sum of prices paid in that district by the weighted sum of average prices paid by all districts in the state. The index for the i^{th} district, p_i, is[1]

$$p_i = \frac{w_{ti}T_i + w_{ni}N_i + w_{oi}O_i}{w_{ti}\bar{T} + w_{ni}\bar{N} + w_{oi}\bar{O}}.$$

If we were to adjust revenues available to each school district by multiplying the initial or basic amount by the value of this index we should have succeeded in ensuring that, for all districts, the quantity of inputs purchasable with a given initial amount of revenue is the same. Thus, for example, in a system of fully centralized state financing, assuming that each

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[1] As presented in the text the index for each district is constructed with the use of its own budget weights in both the numerator and denominator. The virtue of this approach is that it does not produce incentives to shift the input mix from that which would have been selected in the absence of the adjustment index. Alternatively, one might prefer to substitute weights derived from state-wide budget aggregates for use in the denominator. We carry no special brief for either of these alternatives. The index based entirely on the district's own budget weights perhaps affords the simplest response to the problem of input price differences. It gives us the ratio between the actual district budget and the amount that the budget would cost if its inputs were purchased at prices equal to their state-wide averages.

district's "needs" were the same, we would simply distribute to each district the same basic sum per pupil multiplied by the index of relative input prices. Similarly, for equal yield, percentage equalization, or foundation aid programs, each district's input purchasing power per dollar of initially available revenue could be made equal to that of every other district. Some districts, those for which the index value exceeds 1, would receive supplementary funds, while those for which it falls short of 1 would receive correspondingly less.

But this index is inappropriate because high input prices, particularly in the case of teaching and non-teaching personnel, may be a consequence of local choices as well as forces over which local authorities have no control. Thus, for example, high salaries may be attributable to aspects of community preferences rather than exogenously given characteristics of that community. To the extent that this is the case there would appear to be no warrant for upward adjustment of local revenues. The objective of equalizing input purchasing capacity should not be permitted to encourage and, in effect, subsidize local choices favoring relatively high price inputs when price is, in substantial degree, subject to local control. In addition, with prices of inputs influenced by both demand and supply in the local market, we should not wish to reward influences on demand such as high income or wealth, or such influences on supply as the strength and militancy of district union locals.

The ideal cost adjustment index would be a composite which would take account of all inputs, essentially a variant of the ratio of weighted local to weighted average prices index set out above. Gaps in our data as well as in our methodology, however, preclude our attainment of that ideal. Instead

we shall develop a cost adjustment index for teachers' salaries which, in the aggregate, average about 55 per cent of total current general operating expenditures of Michigan school districts. Then, in descending order of confidence and sophistication, we shall construct similar indices for non-teacher instructional expenditures and non-instructional current operating expenditures per pupil. A composite cost adjustment index may then be constructed for each district simply by computing a weighted average of the separately estimated indices, the weights being given by budget shares.

TEACHERS' SALARIES[1]

The Model

We need to be able to identify and measure those influences on teachers' salaries which should be permitted to govern the size of the cost adjustment index for each district and those influences which should be neutralized. To this end, what is wanted is a model that explains the behavior of teachers' salaries in terms that may be specified in the form of equations which then can be estimated with available data.

The effort to develop a model of the market for teachers begins with the premise that the demand for teachers, like that of other school inputs, is derived from the demand for the output of the schools as productive enterprises. Assuming that the production function defining the relationship of input to output is known as well, then the demand-price for teachers is given by

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[1] For references to and discussion of the literature on empirical estimation and analysis of teachers' salaries, see Brazer op. cit., pp. 97-101, and the papers by Grubb and Kenny et al. appearing in this volume. More general studies of broader labor markets that have yielded some useful insights are Joseph R. Antos and Sherwin Rosen, "Discrimination in the Market for Public School Teachers" (Department of Economics, University of Rochester, mimeo, 1974); Roger W. Schmenner, "The Determination of Municipal Employee Wages," Review of Economics and Statistics, February 1973; and George E. Johnson, "The Demand for Labor by Educational Category," Southern Economics Journal, October 1970.

$P_Q \cdot \frac{dQ}{dT}$, where P_Q is the price or value per unit of output and $\frac{dQ}{dT}$ is the marginal product of teachers (the addition to output that accompanies the addition of a unit of input -- i.e., teachers). This is simply to say that schools, as producers of output called "education", would be willing to pay, for various quantities of teachers, a salary equal to the value of the teachers' marginal product at each of those quantities.

The supply of teachers to a given school district, on the other hand, assuming a competitive market in which there are many employers and no collective bargaining, may be seen as a horizontal line, the height of which depends on the type of community, the characteristics of the students and the schools, alternative opportunities available to teachers, and other conditions or circumstances that make one school district a more or less attractive place in which to teach than another.

In this model, then, the supply function may be defined as

$$S_{si} = f(T_i, P_i, C_i) \qquad (1)$$

where S_{si} is the salary for teachers in the district and P_i and C_i are, respectively, a vector of characteristics of the pupils in the i^{th} district, and a vector of the community's characteristics. T_i, the number of teachers, enters the function with a coefficient of zero, given the assumption of a competitive market.

The actual number of teachers hired by the district will be governed by the quantity, T_i, at which S_i is equal to the value of the marginal product of teachers, that is, where the condition

$$S_i = P_{Qi} \cdot \frac{dQ_i}{dT_i} \qquad (2)$$

holds. Since the supply function is, by definition, a horizontal line, the demand function will govern the number of teachers hired, but it will not influence the salary or price paid. The latter depends exclusively on the level of the supply function.

This model of the determination of teachers' salaries is useful primarily as a means of facilitating one's thinking about why teachers' salaries may be expected to vary among school districts. But it is an abstraction and does not lead directly to specification of demand and supply equations. Some major obstacles to the understanding of the demand function stand out. One is that the product of the enterprises we are concerned with, public elementary and secondary schools, is not one but several products.[1] These products consist, among other things, of the following: 1) the additions to human capital in the form of the acquisition by students of cognitive and other skills as well as a store of information, a private capital good; 2) baby-sitting or custodial services, amusement, and recreation, private consumption goods; 3) provision of information about students' characteristics, essentially a screening service for pupils, parents, colleges, and employers, a good the benefits of which are probably largely or entirely appropriable by individuals or firms, in part as consumption, in part as investment, and in part as an intermediate good; and 4) "socialization" of the child, the contribution of the schools to the ability of the child to function effectively as a member of the community, primarily a public good.[2] This multiplicity of outputs is difficult

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[1] On the nature of the product of schools, see J. E. Stiglitz, "The Demand for Education in Public and Private School Systems," Journal of Public Economics, November 1974.

[2] This list is meant to be illustrative rather than exhaustive. Some observers would add to it improved health and physical fitness and higher need achievement or motivation, and a veritable laundry list of outputs, real or imagined, may be found in any curriculum director's statement of "goals and objectives".

to define, and not readily amenable to measurement. Quite obviously, definition and measurement of the product of the enterprise are necessary if we are to take even preliminary steps toward understanding the production function. That is to say, we must first ascertain what it is that teachers as educational inputs do, and what impact their actions have on educational output.

Even if we knew all we need to know about the production function, however, there would remain the problem of ascertaining appropriate values or prices to attach to the various products of the school system. Since attendance, generally, is required by law of all children from the age of six to sixteen, and the public schools are "free", in the sense that no price is charged for admission or attendance, we have no direct measure of the values appropriate to these products. Our indirect measures, such as the net present value of the increment to one's income associated with an additional year of schooling, are, at best, averages that shelter very large differences. In the case of such functions as baby-sitting, knowing what rates people pay for similar services in the private sector is of little help because compulsory attendance rules out choices at the margin where price matters. Thus in the public schools one is faced with an "all or else" kind of non-option (attendance for 180 six-hour days, say, being required), and there is no way of answering the relevant question, "what is one hour more worth?" Perhaps a set of "shadow" prices, prices that people might be presumed to be willing to pay if choices were available, could be constructed, but it seems a huge task that has not, to our knowledge, been undertaken.

Thus, we cannot offer a sophisticated model of demand for teachers that looks like the "real world". What we can do, however, is make some intelligent

guesses about the nature of that demand and the factors that are likely to influence it. We may reasonably expect that the number of teachers a school district will wish to hire will be larger at lower than at higher salaries. This follows from the supposition that teachers are, in some degree, substitutable for other school inputs. In addition, when more education can be had at a lower price to the community, its members may then be willing to substitute education for other private and public goods.[1] We assume, further, that education is a "normal" good, one the consumption of which rises as income goes up. We therefore expect the demand for education and the derived demand for teachers to be a rising function of income or some other index of wealth, taxable capacity, or ability to support education. Tastes or preferences, competing demands for tax dollars, and other characteristics of or conditions confronting the community, which we shall specify in detail, may also be expected to influence the demand for whatever it is that people perceive as the products of the school system and, hence, again, the derived demand for teachers.

Thus we may envision the demand function for teachers as

$$S_{di} = f(T_i, X_i, Y_i), \qquad (3)$$

where S_{di} is the demand price or salary of teachers, T_i is the number of teachers hired, X_i is a vector of community taste or preference variables,

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[1] If, as indicated above, the district hires teachers until $S_i = P_{Qi} \frac{dQ_i}{dT_i}$, then if, as seems reasonable, $\frac{dQ_i}{dT_i}$ declines as the number of teachers (T_i) increases, the number of teachers will vary inversely with salaries as the prices paid for teachers, assuming that P_{Qi} remains constant or declines as T_i increases. For utility maximizing households we assume that marginal rates of substitution between pairs of goods purchased are equal to the ratio of their prices. Normally, then, when the price of one good falls continued maximization of utility requires purchase of more of it relative to other goods.

and Y_i is a vector of variables relating to ability or capacity to support education.

The supply function suggested in (1) needs to be modified to fit the "real world" in recognition of the monopsony or oligopsony position of the school district in the market for teachers. In addition, in Michigan teachers in all school districts are organized and their salaries and other conditions of employment are set out in negotiated union contracts. The first of these circumstances suggests a positively sloped supply function. The second condition, however, brings us back to the horizontal schedule associated with the competitive market situation because the negotiated salary rate is the only rate that may be paid by the district. The model must also be modified in order to take into account the strength and militancy of the local unions. Thus the supply function may be written as

$$S_{si} = f(T_i, P_i, C_i, U_i), \qquad (4)$$

where U_i represents an index of union strength, and, as before, T_i, P_i, and C_i represent, respectively, the number of teachers hired, a vector of the characteristics of the pupils, and a vector of community characteristics.

In the market for teachers' services one important difference from other input markets stands out in a disquieting way. It derives from the fact that, within a rather broad range, the number of pupils in each district may be assumed to be given independently of the number of teachers employed.[1] The number of teachers may be transformed to a teacher-pupil ratio for "normalization"

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[1] ents are influenced to move their children into
is the pupil-teacher ratios change, or that
m a community for the same reason. We assume
egligible.

of this variable without departing from the actual nature of the variable. But as that number increases and the pupil-teacher ratio declines, an important dimension of the terms and conditions of employment changes. As the number of teachers hired increases they should be willing to accept lower salaries, other things equal, because working conditions as given by the pupil-teacher ratio, are improving. As a consequence our supply function does not really contain a "pure" quantity argument.

With respect to the demand function this problem may not present any unusual difficulties. Demand for teachers is assumed to be derived from the demand for their product. As the quantity of teachers hired and the teacher-pupil ratio increase presumably total output increases (that is, marginal product is positive), because pupils may be expected to learn more in smaller rather than larger classes, be better cared for, more effectively amused, and so forth. Thus to the extent that the production function, together with values attached to outputs, governs the demand for teachers, no special problem arises with respect to the quantity variable.

Because of the relationship between quantity of teachers and working conditions on the supply side of the market, it is not surprising to find that teacher contracts negotiated between the union and the school board focus not only on compensation (salary plus fringe benefits) but also on the pupil-teacher ratio (as well as other working conditions). Bargaining, therefore, leads not to the standard picture in which at the negotiated wage rate the district may hire as many teachers as it chooses, but to agreement on a total wage bill, jointly determined by salary rates and the pupil-teacher ratio.

We can then envisage a model of teacher salary determination in a bargaining theory setting. Teachers' immediate goal is to maximize the size of the wage bill, with the trade-off between salary rate and pupil-teacher ratio

(that is, number of teachers hired) being given by that combination of the two that maximizes their utility. On the other side of the bargaining table the school board may be assumed to be motivated by the desire to remain in office. Most simply, this may be seen as depending on their ability to satisfy the preferences of the median voter with respect to levels of educational services supplied relative to the tax rate that voter is willing to pay.[1] Thus the school board, like the teachers, may wish to push the wage bill (or budget) to as high a level as is consistent with a desired probability of re-election, given various salary and pupil-teacher ratio mixes. Presumably the preference of the school board and its electorate (or the median voter) favor minimizing the pupil-teacher ratio at the expense of salary rates. Thus we can envisage a bargaining process in which budget levels and salary rates are jointly determined in the course of negotiations.

Unfortunately, while we find this view of teachers' salaries determination appealing as a means of approaching a "real world" model, we have not been able to construct such a model in terms of mathematical relationships that lead to the specification of equations that may then be estimated. Recognizing its limitations and deficiencies, we are, nevertheless, forced to stay with our demand/supply model, a model which does permit inclusion of some of the forces that one would incorporate into a bargaining model. And the general, intuitive outline suggested for the latter should help to inform our interpretation of our empirical findings.

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[1] On the role of the median voter in determining levels of supply of public services, see A. Breton, "A Theory of the Demand for Public Goods", Canadian Journal of Economics and Political Science, November 1966; R. Barlow, "Efficiency Aspects of Local Expenditures", Journal of Political Economy, November 1970; and W. S. Comanor, "The Median Voter Rule and the Theory of Public Choice", Journal of Public Economics, Jan.-Feb. 1976.

The Estimating Equations

The measure of teachers' salaries that we have chosen to estimate is the average salary paid to all teachers in the school district (ATS). Alternatives might include the beginning or maximum salaries paid to teachers with a B.A. or with an advanced degree. But the cost of inputs in the form of teachers seems to us best represented in the average salary paid. Ideally we should perfer to use average compensation, the sum of salaries plus fringe benefits. Unfortunately, however, reliable data on fringe benefits are not available. Our estimates and, therefore, our cost adjustment indices will be deficient to an extent that depends on the cost of fringe benefits relative to salaries and on the differences among school districts in the ratio of total compensation to salaries. Clearly if this ratio were the same for all districts the relative size of fringe benefits would be unimportant and our index would be unaffected by the failure to include fringe benefits in our salary measure. We suspect, however, that there is considerable variance in this ratio and that its size does matter, but we do not know how much.

The estimation of ATS requires the specification of the demand and supply functions as equations. Some explanatory variables will influence ATS through both demand and supply, thus requiring that we estimate our system of two equations simultaneously, and because some predictor variables are endogenous rather than exogenous to the system the use of two-stage rather than ordinary least squares regression is required. The use of 2SLS to estimate a system of equations, as opposed to the estimation of a reduced form of the equations, [1] should provide consistent estimates of the parameters of our equations.

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[1] As in our earlier study, op. cit..

For both equations we specify linear, additive relationships between ATS and the predictor variables. In addition to the dependent variable, variables specified as endogenous in the demand equation are TPUP, the number of teachers employed per thousand pupils, included for reasons discussed in the foregoing section, and MILLV, extra voted millage, a variable that represents preferences for education but which, like TPUP, is likely to be influenced by the same forces that govern variance in ATS.[1] Two other variables may be regarded as endogenous as well. They are the mean number of years of teaching experience of teachers in the district (AYTE) and the proportion of teachers who hold master's and other advanced degrees (PTECM).[2] They are clearly endogenous if school districts are free to choose among teachers of various levels of experience and education. With respect to newly hired teachers districts can exercise some discretion in these respects. But once teachers have been hired and granted tenure, especially if most are initially employed as new B.A.'s, the employing district loses control over how much education and experience they may subsequently acquire. All districts in Michigan have negotiated salary schedules that require payment of salary increments up to stipulated limits for degrees or credits beyond the B.A. and for longevity. As long as such schedules and more or less uniform tenure rules exist, school districts cannot be said to be in substantial control of the education and

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[1] And is therefore likely to be correlated with the residuals from the demand equation. TPUP is endogenous in the supply equation because it is entirely plausible that it is correlated with the residuals, that is, with variables that contribute to explanation of variance in ATS but which have been omitted from the supply equation.

[2] Higher salaries generally tend to be associated with higher values of both of these variables. For our Michigan sample of school districts the simple correlation coefficient for ATS and AYTE is .39, and the coefficient for ATS and PTECM is .73.

experience of their teachers. We prefer, therefore, to treat AYTE and PTECM as exogenous variables in the supply equation.[1] We expect that a more experienced teacher corps with more education credits will, other things being equal, yield higher ATS.

The cost adjustment index to be developed will rely on estimated regression coefficients drawn from our supply equation. As noted, however, in order to obtain consistent and unbiased estimates of these coefficients we estimate both demand and supply equations using simultaneous 2SLS. In this process the specification of the demand equation plays a major role and we turn first to that specification.

Demand

We expect that at lower salaries, other things being equal, each district will wish to hire more teachers. Thus the endogenous variable representing number of teachers hired, TPUP, should appear in our equation with a negative sign.

In Michigan virtually all school districts rely for local source funds primarily on "allocated" millage, the schools' share of non-municipal property taxes that may be levied without voter approval, and "extra-voted" millage, subject to approval by referendum at irregular intervals. In 1972-73, the year to which our school data apply, the mean operating levy for schools was approximately 26 mills, with allocated millage ranging from about 6 to 11

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[1] For those who disagree or who are curious, we should be pleased to provide, on request, the alternative estimated demand and supply equations in which these variables are treated as endogenous in the supply equation. We note here that the demand equation is not much affected by this change in assumptions, but the predictive power of the supply equation is reduced appreciably and the regression coefficients for the endogenous AYTE and PTECM are not statistically significant. This reflects simply the fact that these variables are not well explained by the other variables in our system.

mills. For most districts extra voted millage (MILLV) is at least equal to allocated millage, and for many it is two to three times as high. Its range in our sample is from 3 to 29 mills, with a mean of 16.3. Given the foundation program of state aid that existed in Michigan in 1972-73[1] and the value of taxable property in the district, it is the level of extra-voted millage approved by the community that largely governs the amount of revenue available, for teachers' salaries as well as other objects of educational expenditure. Thus we view MILLV, an endogenous variable,[2] as an indicator of the community's willingness to support education, influenced by its tastes, by voters' perceptions of the "price" to them of a dollar in local taxes, given in part by the structure of the local tax base, and other factors.

We enter into our demand equation a group of variables that are expected to govern or reflect the community's preferences with respect to education. These are public school pupils as a proportion of the total population of the school district (PPUPOP), proportion of the population that is foreign born or whose parents were born abroad (PFOR), the proportion of the population aged five and over who lived in the same house in 1970 as in 1965 (MOB), and the proportion of the adult population who had attended college for at least one year (PCOL).

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[1] An equal-yield approach was adopted in the following year.

[2] In the reduced form equation in which MILLV is estimated as a function of all of the exogenous variables in the system, $R^2 = .68$ and statistically significant positive regression coefficients were obtained for PTECM, PNW (percent of the population non-white), MLEMP (average annual earnings of all male employees in the county aged 16 and over), and REVPL (per cent of school revenue from local sources). The coefficient on SEVP (state equalized value of taxable property per pupil) is negative and significant at better than the .01 level. In general these results lend limited credence to our specific hypothesis.

PPUPOP is a composite variable that is the product of two ratios. It is the proportion of the population that currently attends any school in grades kindergarten through 12 multiplied by the proportion that those attending public schools represent of all pupils. We expect that interest in and concern for education varies directly with the number of school age children in the community relative to the total population and that given that relation, demand for public school services is enhanced where the role of private and parochial schools is small. Thus, holding other things constant, we anticipate that the demand for public school teachers increases with the size of PPUPOP.[1] Its influence may be attenuated, however, by the fact that the larger the value for PPUPOP the greater is the burden to be met in the public sector of the educational system. Thus more widespread interest and concern may be at least partially offset by higher PPUPOP imposing a larger total obligation on the community.

The range of PPUPOP is substantially wider than one might expect. It is as low as 10.5 per cent in one district while in another, at the extreme, just under 35 per cent of the total population attends the public schools. The mean value is 25.5, with a standard deviation of 3.9.

Traditionally, the immigrant's access to the "mainstream" of society in America, his avenue to social acceptance and economic achievement, has

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[1] It should be kept in mind that in our demand and supply equations we have normalized for differences in district size in terms of numbers of pupils by dividing quantity of teachers by number of pupils. Therefore, in terms of our demand/supply equations, ATS is viewed as a function of, among other things, TPUP, or teachers per 1,000 pupils, rather than T, simple number of teachers. Thus "demand for teachers" is generally properly read to mean "demand for teachers per pupil". To omit this normalization for size would involve inserting weights proportionate to size into our estimation procedures. Instead, in our procedures Detroit counts no more heavily than the smallest district.

been the public school system. Immigrants and the children of immigrants are less likely to take the schools for granted, more likely to feel dependent on them for upward mobility, and more likely to be appreciative of the opportunities they provide. Thus they should be more strongly supportive of education than the public at large. We believe, therefore, that the demand for education, and the derived demand for teachers, should increase with increases in PFOR, a variable that ranges in value in our Michigan sample from a low of 4.9 to a high of 53.5 per cent, with a mean of 17.5 per cent.

Michigan communities vary widely in the mobility of their populations. Some are older, long-settled cities, suburbs, or rural areas, while others have recently experienced rapid population growth. Older cities may also have highly mobile populations, especially if a large proportion of their residents are renters rather than home owners. Our variable, MOB, is designed to capture this kind of difference among school districts. In 1970, 55 per cent of the population aged 5 and over lived in the same house as it did in 1965. In one district only 17.5 per cent of the population had not moved in the five-year period; in another, at the other end of the spectrum, close to three-quarters of the population were in the same house and therefore not only in the same school district but, very likely, in the same school attendance area. It is our hypothesis that longer association with a particular school and a given school district tends to generate loyalties and supportive attitudes that increase effective demand for the services of the schools and, therefore, for teachers. Thus we expect that ATS is positively associated with the value of MOB.

We believe that education breeds more demand for education. Our measure of the educational level attained by residents of a school district is PCOL,

a variable for which we anticipate a positive relationship with ATS. Less than a fifth of Michigan's adult population reported having been to college for at least one year as of the 1970 census, but the variance among school districts is very large, with the range extending from 5 to 72 per cent, and the standard deviation equal to 10.[1]

The next set of arguments in our demand equation consists of variables which measure ability or capacity to support education. They are PRICH, the proportion of families in the district whose 1970 Census reported 1969 income was $15,000 or more; SEVP, state equalized value of taxable property, the district's 1972-73 tax base per pupil; and TAXO, total non-school tax levy imposed on property in the district.[2]

One may readily question whether the appropriate measure of income as a determinant of demand for teachers is median family income or the proportion of families that either suffer low or enjoy high incomes. Obviously the correlation among these measures is high,[3] and the choice is somewhat arbitrary.

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[1]PCOL may also pick up some of the influence of income, since the simple correlation coefficient measuring its association with median family income (MFY) is .68.

[2]Where, as in Detroit and a number of other cities, there is a municipal income tax its yield was divided by the property tax base to obtain a property-tax equivalent rate which was added to other non-school millage to obtain TAXO.

[3]The correlation matrix for PRICH, MFY and PFPOV (proportion of families with incomes of less than $4,000) is:

PRICH	---		
MFY	.95	---	
PFPOV	-.80	-.73	---

We selected PRICH because of the belief that the rich are likely to be more articulate, more often represented on school boards, and generally more influential in public decision making than the poor. The mean sample value of PRICH is 26.5 per cent, but it runs from a low of 4.1 to a high of 81.8 per cent.

The influence of PRICH or PFPOV is not unambiguous, however. On the one hand a high proportion of the population being rich should lead to a high demand for education, but assuming that high income generally means high-value of owner-occupied house, it also implies a high price for education as seen by the taxpayer-voter. Thus the high income individual may prefer a low level of expenditure for education. Moreover, the influence of perceived price may be reinforced by greater ability to afford private education and by the fact that rich heads of households may be older and have fewer children in school. On the other hand, being poor (income under $4,000 in 1969) suggests a low demand for education, but the price to the poor is low as well, perhaps perceived as zero in the case of renters. Thus countervailing influences may offset each other and estimation of our demand equation may yield either a positive or a negative coefficient, which, in either case, is not likely to be statistically significant.

In our sample of school districts the value of state equalized taxable property per pupil (SEVP) averaged $20,249 in 1972-73. Its variance, indicated by a standard deviation of $8,975 and a range of $5,942 to $67,119, was quite large. SEVP may be seen as a "wealth" argument in our demand function. Its influence, however, is unlikely to be simple in a sample of school districts of highly diverse economic characteristics. High SEVP can mean high valued houses owned by high income people in a school district like Bloomfield Hills;

in Ecorse or River Rouge it means low-valued residences occupied by low income people and a great deal of industrial property; while in Harbor Springs it is high because summer resort residences add to the tax base but not directly to the local school population. We should expect that the tax base will be more heavily exploited in communities like River Rouge and Harbor Springs than in Bloomfield Hills.[1] Nevertheless, the influence of SEVP on demand for teachers should be unambiguously positive.

It is frequently argued that the larger cities are at a disadvantage with respect to their ability to finance education because of the large tax burden imposed on their residents to support municipal public services. To the extent that municipal taxes are perceived as a drain on income we should expect TAXO to be a negative influence on demand for education and hence teachers' salaries. But high municipal taxes may reflect high preference for public services and one might even suspect that these taxes cum public services yield overall consumer surpluses which make people better rather than worse off. The fact that TAXO and MILLV are uncorrelated[2] does not support the "municipal overburden" hypothesis. Nevertheless, given the wide range in TAXO in our sample, from 9.3 to 55.0 mills, with a mean of 22.8, the relationship between it and ATS seems worth exploring.

Finally, we include in our demand equation two variables designed to reflect actual or perceived views of the local cost of education to taxpayers per

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[1] See Harvey E. Brazer, John S. Akin, Gerald E. Auten, and Cynthia S. Cross, Fiscal Needs and Resources: A Report to the New York State Commission on the Quality, Cost, and Financing of Elementary and Secondary Education (processed, Ann Arbor, 1971), for evidence suggesting that seasonal, industrial, and commercial property tends to contribute much more heavily to local tax receipts than residential property.

[2] $r = -.06$

dollar of tax or total revenue realized. These are RES, the proportion of the total SEVP that is accounted for by residential real property, and REVPL, the proportion of total local school district general revenue that is provided from local sources.

RES, which ranges from 7 to 81 per cent and averages 48.9 per cent, may be seen both as a price or cost variable and as a proxy for type of community. In the latter respect, however, its influence may be mixed because a low value for RES may indicate either that the district is rural or, at the other extreme, very heavily industrialized. A high value would more or less consistently imply that the district is largely residential in character, but we are unable to distinguish between rental and owner-occupied properties. Nevertheless, on balance we should expect RES to be negatively, though perhaps weakly, associated with ATS.

Because the local price of a dollar of general revenue for education may be seen in the value of REVPL, we should expect that ATS will vary inversely with the size of this predictor variable. On the average local districts supply about 55 per cent of their revenues, but at one extreme this proportion descends to 11 per cent and, at the other, it reaches 98 per cent. Our principal misgiving with regard to the use of this variable derives from its high correlation, at .90, with SEVP. But the latter is expected to be positively associated with ATS and if the standard errors of the coefficients prove to be relatively small we should not be troubled by a problem of multicollinearity.

In summary, we may set forth the demand equation to be estimated as:

$$ATS_d = a - b_1\ TPUP + b_2\ MILLV + b_3\ PPUPOP + b_4\ PFOR + b_5\ MOB + b_6\ PCOL + b_7\ PRICH + b_8\ SEVP - b_9\ TAXO - b_{10}\ RES - b_{11}\ REVPL + \mu \quad (5)$$

where a is the constant term, the b_i's are the regression coefficients, and μ is the error term.

Supply

In specifying the supply equation to be estimated we stipulate, on the basis of our model, that TPUP should carry a regression coefficient not significantly different from zero. The characteristics of the teachers employed, of the pupils, and of the community, together with measures of union strength and/or militancy, may be seen as "shift parameters", moving the supply function up or down.

Ideally, we should like to have an index of teacher quality, but once the salary scale is established for a given district it is not at all clear that quality matters. We have not been able to uncover any evidence suggesting that brighter, more "able" (whatever that means in teachers) teachers command higher salaries. In any event none of the variables available to us with regard to teachers appears to make any difference, except for education and experience. However, experience and education beyond the B.A. are built into each district's salary scale. We anticipate, therefore, that AYTE, the average years of teaching experience for the district's teachers, and PTECM, the percentage of teachers with advanced degrees, will be positively associated with ATS. Both of these predictors exhibit considerable variance, AYTE around a mean of 8.9 years, with a range of 4.1 to 14.8 years, and PTECM around a mean of 29.6 per cent, with a range of 4.3 to 66.8 per cent.[1]

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[1]The standard deviations are, for AYTE, 2.2 years, and for PTECM, 12.1 per cent.

Characterizing school systems in ways relevant to the supply function for teachers is difficult too. One readily available and quantifiable characteristic, however, is size. Our hypothesis is that as the size of the district rises, as measured by the number of pupils, bureaucratic oversight, paper shuffling demands imposed on teachers, distance between the teacher and the policy-maker, and the incidence of frustration in dealing with administrators all increase. We specify a semi-log relationship with ATS, arguing that ATS is a positive function of the logarithm of the number of pupils in the district (LPUP). This is to say that, other things being equal, teachers prefer smaller to larger school districts, but increments in size take on an importance that declines as size increases in our sample, from a low of 460 to Detroit's 280,000.

Another aspect of the school district that we expect to enter into the supply function is the achievement level of its pupils. Teachers, having gotten through high school and college, are presumably average or better achievers, and we assume that they are most comfortable with similarly characterized pupils. Our measure of pupil achievement level is the district's average 1971 fourth grade "Basic Skills Composite Achievement" score (SKCF). The variance in this measure is small, however, and its predictive power with respect to ATS may be small as well. The sample average for SKCF is 51, while the standard deviation is only 2.6. Nevertheless, we expect that the relationship between SKCF and ATS is negative; teachers may be found to be paid less, everything else remaining constant, where achievement scores are high.

The average proportion of teachers who are males barely exceeds 40 per cent, the range running from 28.6 to 58.3 per cent. Given the higher-salaried alternative employments available to males, and the greater frequency with

which female teachers are "secondary" rather than "primary" earners in the household, we anticipate that higher average salaries must be paid as the proportion of teachers who are males (PMALES) rises.

We presume that teachers are subject to preferences regarding communities and to alternative opportunities that influence the salaries they are willing to accept. Among the community-related variables we believe to be relevant in this context are the type of community, in terms of whether it is a central city (CE), rural district (RUR), suburb (SUB), or independent city (the "control" type, consisting of school districts that are not in a SMSA and which contain a city having a population of between 4,000 and 50,000)[1]; the proportion of the population that is black or has a Spanish surname (PNW); median family income in 1969 in the district (MFY); the population density of the county (DENS); the average annual earnings of employed males aged 16 and over (MLEMP); and the proportion of the population in the district with one or more years of college (PCOL).

By and large the hypotheses associated with these community characteristics seem straightforward and generally unambiguous. We believe that, other things being equal, teachers require extra compensation to accept and keep employment in a central city school district. This view stems in part from observation of the exodus of non-teaching employment opportunities from the central city which, coupled with the large proportion of teachers who are second earners in the family, makes a position in the central city less attractive. In addition, central city school buildings tend to be older and offer less attractive

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[1]This classification of school districts gives us three "dummy" or dichotomous variables. A district is assigned a value of 1 if located in a central city (CE), 0 otherwise; 1 if rural (RUR), 0 otherwise; and 1 if suburban (SUB), 0 otherwise. The regression coefficients estimated may then be read as differences in ATS attributable to the district being classified as one of CE, RUR, or SUB, as opposed to its being in or containing an "independent" city.

teaching environments, anticipated slower growth may afford fewer opportunities for advancement to supervisory and administrative jobs, and other circumstances more likely to be found in the central city than elsewhere may require so-called "combat pay".

The suburbs, on the other hand, may be seen as attractive places to work and live, as appears to be increasingly the case for rural communities, especially those that offer low-cost living opportunities and ready access to open spaces and the amenities of outdoor recreation.

Michigan school districts vary enormously in the relative size of their minority populations (PNW),[1] from 0 in 20 districts in our sample of 173 to a maximum of 69.5 per cent. The mean for the total sample is 4.6 per cent, far less than the mean for the population because each district is weighted equally and the larger central city districts are therefore under-weighted. The distribution of the non-white population in Michigan, with a heavy concentration in a few central cities and some older close-in suburbs makes it difficult to separate the influence of this variable from that of other characteristics of these communities. We enter PNW in our supply equation because it is a variable of major interest to many observers rather than because our model of the market for teachers or our intuition offers a compelling hypothesis as to its influence on or association with the level of ATS.[2] PNW, being highly correlated with low socioeconomic status, implies characteristics that are seen as making children difficult to teach. Thus we expect ATS to rise with PNW, other things being equal.

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[1] Our data relate only to black and Spanish surname minorities, omitting native American and Orientals.

[2] Even when other factors, such as kind of community, SKCF, MFY, PCOL, and so forth are not held constant, the relationship between PNW and ATS is not close. The simple correlation coefficient at .25 is, while statistically significant, rather modest.

Teachers are as susceptible to the pressure to conform, to emulate one's neighbors in consumption patterns and levels, as anyone. Median family income (MFY) is included in our supply equation to reflect this premise. We expect that teachers will require higher salaries in relatively high communities. Among the school districts in our sample the mean value of MFY as reported in the 1970 Census for 1969 was $12,275. But the standard deviation of $3,095 suggests substantial variance, as does the range of $6,885 to $33,964.

Michigan's school districts are located in counties in which the density of population (DENS) ranges from a low of 9 to a high of 4,414 people per square mile. The influence of population density of the area on the supply function for teachers could reasonably be either positive or negative. Some people place a high value on the cultural and social amenities that are available only where population density is sufficient to support them. Others obviously are more willing to forego these amenities, or travel further to reach them, in order to realize their preference for avoiding the congestion, high land prices, and other undesirable aspects of living where population density is high. Increasingly "quality of life" and low density appear to be closely and positively associated. For teachers we should expect that the indicated opposing forces of DENS will yield a small net positive influence on their supply price.

The measure chosen to represent the opportunity cost of teaching in our supply equation (MLEMP) is the average annual earnings of male employees aged 16 and over in the county in 1969.[1] The mean value of MLEMP is $8,818, while

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[1]We experimented at various stages of the study with several alternatives, including the earnings of female clerical and kindred employees; professional, managerial, and kindred workers; and operatives. We settled, finally, on MLEMP because it seemed to us to have a small edge, logically, on any of the others and because it did produce a better fit.

it is as low as $5,449 in one county and reaches a high of $10,881 in another. The mean of $8,818 for 1969 is very close to the mean ATS for the sample of school districts of $ 11,800 when it is increased at the rate of 10 per cent per year from 1969 to 1972. In any event, we expect that as MLEMP increases school districts must pay higher salaries to keep their teachers.

Because teachers are college graduates we believe that, other things being equal, they prefer to live and work in communities where a relatively high proportion of the population has attended college (PCOL). The variance among school districts in PCOL, as we noted in connection with its role in the demand equation, is enormous. Whereas we believe that an increasing value of PCOL tends to increase the demand for education and therefore teachers, we expect that it is a negative "supply shift" variable. That is, when other relevant factors are taken into account in the supply equation we anticipate that teachers will be found willing to accept a lower salary in a district as the proportion of the adult population with one or more years of college rises.

Because teachers in all school districts in Michigan are unionized, and only Detroit and a few others in Wayne County are not affiliated with the Michigan Education Association, we cannot test for the influence of unionization as such on the supply price of teachers. But union strength and militancy may be important arguments in our supply function. We have employed two variables designed to reflect these union characteristics. The first is the number of days that teachers in the district were out on strike during the three years 1970 to 1972 (STRK). During our period of observation the maximum number of days teachers were on strike in any district was 21, while most of the districts experienced no strike at all. Thus the mean value for STRK is only 1.6, but its standard deviation is 4.4. The second variable concerns the presence or

absence of two elements in the union contract, the agency shop provision and binding arbitration. About three-quarters of the districts in our sample do have teacher contracts that contain one or the other of these provisions, but the proportion of contracts that contain both is 62 per cent. Our second measure of union strength thus is the "dummy" variable, CNTRCT, assigned the value 1 if the district contract contains both the agency and binding arbitration clauses, and 0 if it contains only one or neither of them.

We expect the estimated parameters for both STRK and CNTRCT to carry positive signs. We envisage them as shifting the supply function upward appreciably.

In summary our estimating equation for the supply function, with the expected signs of the regression coefficients indicated, is as follows:

$$\begin{aligned} ATS_s = c &+ d_1 TPUP + d_2 AYTE + d_3 PTECM + d_4 LPUP - d_5 SKCF + d_6 PMALES \\ &+ d_7 CE - d_8 RUR - d_9 SUB + d_{10} PNW + d_{11} MFY + d_{12} DENS + d_{13} MLEMP \\ &- d_{14} PCOL + d_{15} STRK + d_{16} CNTRCT + \gamma. \end{aligned} \tag{5}$$

where c is the constant term, the d_i's are the regression coefficients, and γ is the error term.

The Regression Results

We used two stage least squares regression for estimation of our demand and supply equations. The data relate to a sample of 173 K-12 school districts in Michigan which were included in the combined 1970 Census Fourth Count (Population) School District Data and the 1970 Elementary-Secondary General Information Survey Tapes, known as the "Combined SDDT-ELSEGIS III(SDEL3) Data Tapes". We began with the ELSEGIS III probability sample of 182 districts

drawn from the total of 626 Michigan school districts, including the 530 K-12 that account for 99.7 per cent of enrollment, and 96 elementary districts.[1] Nine districts were dropped from the original sample, the two elementary districts in order to achieve comparability, and the others because of missing data. All of the larger districts are in the reduced sample and it remains, we believe, unbiased and fully representative of the population of K-12 districts.

The estimated demand equation is presented in Table 1. All but one of the signs on the regression coefficients conform to our expectations. In the case of PRICH apparently the negative influence on demand of the high price of education for high income people outweighs the positive income effect, but the coefficient is not quite significant at the .10 level.

The "municipal overburden" argument gains some support from the negative sign of the coefficient on TAXO, but little or no weight can be attached to this finding because the standard error is larger than the coefficient. Precisely the same point may be made with regard to RES, a "price" variable in the form of the proportion of state equalized value of taxable property that is residential. In contrast, the proportion of the district's general revenues that is derived from local sources (REVPL), primarily the property tax, does appear to be both robust in its effect and highly statistically significant. For each 1 percentage point increase in this variable ATS declines by $116 (at the point of averages). As a measure of capacity to support education, and hence teachers' salaries, SEVP, the size of the per pupil local tax base, is most important. The value of its coefficient, at .305, is clearly very large, in that it tells us that ATS rises by $.30 for each $1 increase in SEVP.

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[1] The sampling ratios employed were 1.00 for districts with enrollment in 1969-70 of 4,000 or more; .32 for 2,500-3,999; .13 for 300 to 2,499; and .03 for under 300.

Table 1. Regression Results, Demand Equation for Average Teachers' Salaries (ATS) in 173 Michigan K-12 School Districts, 1972-73

Predictor Variables	Regression Coefficient	Standard Error	't' Statistic	Mean (unweighted)
Constant	15,517***	2700	5.75	----
TPUP[ab]	-294.4***	56.81	-5.18	44.14
MILLV[b]	387.1***	52.04	7.44	16.32
PPUPOP	69.27*	36.65	1.89	25.51
PFOR	33.32*	17.56	1.90	17.50
MOB	24.12	15.63	1.54	55.78
PCOL	52.68**	21.44	2.46	18.84
PRICH	-28.10	17.80	-1.58	26.54
SEVP	.3051***	.0451	6.76	20,249
TAXO	-13.31	16.69	-0.80	22.78
RES	-8.720	9.383	-0.93	48.89
REVPL	-116.3***	24.94	-4.67	55.31
			ATS	11,800

R^2 = .54

S.E. = 1265

σ = 1479

N = 173

* Significant at p < .10
** Significant at p < .05
*** Significant at p < .01

[a] Teachers per 1,000 pupils.
[b] Endogenous variables.

Of the characteristics of the community's population which our model suggests should exert a positive influence on ATS, the regression coefficients for the proportion that is "of foreign stock" (PFOR) and the proportion of adults with a year or more of college (PCOL) are statistically significant at the .10 level or better, while the proportion living in the same house in 1970 as in 1965 (MOB) emerges with a positive coefficient that is not significantly greater than zero. In summary, these community characteristics variables may be said (with varying degrees of confidence) to lead to increases in ATS ranging from about $24 to $53 for each 1 percentage point rise in their respective values.

Our hypothesis with respect to PPUPOP, the proportion of the population that attends public schools, gains some support from the regression results. For each percentage point increase in PPUPOP ATS rises by $69.

Finally, MILLV, the variable that in our model is representative of the community's level of preferences for education is closely tied to ATS. A mill added to extra-voted millage increases ATS by $387. In terms of elasticities, we may note that an increase of one per cent in MILLV is associated with an increase of .5 per cent in ATS.

For construction of our cost adjustment index the estimated demand equation is of secondary interest because our procedure involves assigning the mean value of ATS to each district and then adjusting that value to take account of the relevant supply-shift parameters. The formulation of the demand equation, however, is important since it influences our specification of the supply equation. Moreover, our results with respect to estimation of the demand equation lend support to the validity of our model of the market for teachers.

The estimated supply equation may be seen in Table 2. We find that our supply factors taken together account for 69 percent of variance in ATS. By and large the signs of the regression coefficients are in accord with our expectations, but the coefficients for SKCF, PNW, and type of community (CE, RUR, or SUB), are not significantly different from zero. One might suspect that the lack of significance of type of community might be due to multicollinearity with such variables as DENS and PNW; but the simple correlations are not especially high.

The regression coefficient for our quantity variable, TPUP, was expected to be close to zero. Its estimated value of 53.87 is only 1.5 times its standard error, making it statistically insignificant.

For all of the other predictor variables in our equation the regression coefficients are significant at levels of .10 or better. It is especially interesting to note that our measures of union strength and militancy, STRK and CNTRCT, have estimated coefficients indicating that ATS rises by $30 for each day the district's teachers were on strike between 1970 and 1972 and by $362 when the union contract calls for both an agency shop and binding arbitration.

It apparently does take higher salaries to obtain teachers in districts with high median family income (MFY), high county population density (DENS), and high levels of earnings by male employees in the county (MLEMP). For MFY and MLEMP the coefficients are, perhaps, lower than one might expect, since they suggest that a $1 increase in MFY is associated with a rise in ATS of only about 10 cents, while a $1 increase in MLEMP, representing the opportunity cost of teaching in our model, leads to some 23 cents more in ATS.

Our other community characteristic, PCOL, behaves in accordance with our model. ATS falls by about $29 for each percentage point rise in the proportion of the population with one or more years of college.

Table 2. Regression Results, Supply Equation for Average Teachers' Salaries (ATS) in 173 Michigan K-12 School Districts, 1972-73

Predictor Variables	Regression Coefficient	Standard Error	't' Statistic	Mean (unweighted)
Constant	-591.6	2903	-0.20	-----
TPUP[ab]	53.87	35.88	1.50	44.14
AYTE	193.9***	43.15	4.49	8.860
PTECM	33.22***	10.04	3.31	29.60
LPUP	813.2***	306.7	2.65	3.698
SKCF	-1.152	41.81	-0.03	51.05
PMALES	31.40**	15.11	2.08	40.67
CE	462.8	357.5	1.29	-----
RUR	-184.6	275.8	-0.67	-----
SUB	-59.50	266.0	-0.22	-----
PNW	-1.663	10.37	-0.16	4.619
MFY	.0967*	.0512	1.89	12,275
DENS	.1805***	.0659	2.74	1,087
MLEMP	.2286**	.0963	2.37	8,818
PCOL	-28.73*	14.79	-1.94	18.84
STRK	30.17*	15.97	1.98	1.577
CNTRCT	361.6**	171.0	2.11	-----
			ATS	11,800

R^2 = .69

S.E. = 869

σ = 1479

N = 173

* Significant at p < .10
** Significant at p < .05
*** Significant at p < .01
a Teachers per 1,000 pupils.
b Endogenous variable.

The remaining four variables reflect the characteristics of the teachers and the size of the district. We find that an additional year of teacher's experience (AYTE) adds $194 to ATS. Each percentage point increase in the proportion of teachers holding an advanced degree is associated with a rise of $33 in ATS. School districts that hire relatively more male teachers do appear to pay higher salaries. Our estimated regression coefficient on PMALES suggests that each percentage point increase in the proportion of teachers who are male adds $31 to salaries, almost as much as an equal increase in the proportion holding an advanced degree. Finally, our hypothesis regarding the relationship between size of the district, measured by the logarithm of number of pupils (LPUP), and ATS is strongly supported. We estimate that as LPUP moves from 3 (1,000 pupils) to 4 (10,000 pupils) ATS goes up by $813.

The Adjustment Index for Teachers' Salaries

In the construction of our cost adjustment index for teachers' salaries our objective is to achieve a measure of the extent to which average teachers' salaries paid in each district depart from the statewide mean because of differences among districts in the relevant supply conditions. A district for which the values of the supply equation variables were all equal to the means of those values for the sample as a whole would be assigned an index number of 1. If these values were all above their means and the influence of the supply factors was uniformly positive, its index would exceed 1. It would be less than 1 under the same conditions, of course, if the local observed values lay below the means, and might be greater or less than 1 if some were higher and some lower than the means.

In general terms the expression for the adjustment index for teachers' salaries (AITS) is as follows:

$$AITS = \frac{\overline{ATS} + \sum_{j=1}^{n} d_j (X_{ij} - \bar{X}_j)}{\overline{ATS}}, \qquad (7)$$

where $\overline{ATS}$ is the mean value of ATS for all districts in the sample, the d_j's are the regression coefficients estimated for the variables in the supply equation that are to enter the adjustment index, X_{ij} is the observed value in the i^{th} district for the j^{th} variable, and $\bar{X}_j$ is the sample-wide mean value for that variable.

The variables to be included among the X_j's are the exogenous variables in our supply equation except STRK, CNTRCT, PMALES, PNW, and MFY. STRK and CNTRCT are omitted because their inclusion could be considered an invitation to strikes and changes in bargaining agreements, agreed to by both the school board and the teachers as a means of raising the district's index and thus obtaining additional funds. It seems clear that possibilities for pursuing such obvious self-serving opportunities cannot be incorporated into the adjustment index. Similarly, it would seem inappropriate to provide revenue incentives to districts for increasing the proportion of their teachers who are males.[1] And a negative adjustment for PNW, however small, is not readily justifiable. Nor are we of the view that the adjustment index should increase with MFY. Given the regression coefficients of Table 2 for all of the other variables in our supply equation, the index is calculated as

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[1] Indeed it may be argued that PMALES is properly treated as an endogenous variable in the supply equation.

$$AITS = 11{,}800 + 193.9(AYTE_1 - 8.860) + 33.22(PTECM_i - 29.60)$$
$$+ 813.2(LPUP_i - 3.698) - 1.152(SKCF_i - 51.05) +$$
$$462.8(CE_i - .0800) - 184.6(RUR_i - .1829)$$
$$- 59.50(SUB_i - .5943) + .1805(DENS_i - 1.087)$$
$$- 28.73(POOL_i - 18.84) + .2153(MLEMP_i - 8.818)/11{,}800 \qquad (8)$$

It follows from this method of construction of the adjustment index that we are, in effect, repressing the influence not only of those indicated variables which we believe to be inappropriate for inclusion, but also that of the omitted variables, those that account for the residuals from our estimating equation. These residuals are by no means small, since our equation fails to account for over 30 per cent of the variance in ATS. Our approach is one that tacitly assumes that the residuals are uncorrelated with any influences we might wish to include in the calculation of the adjustment index.

Obviously, of course, the method outlined here is not the only possible one thatmight be used for the purpose at hand. An alternative that gives full rein to the residuals would begin with ATS_i rather than $\overline{ATS}$, and then deduct the sum of the products of the regression coefficients for the variables we do not wish to allow to influence the adjustment index, such as TPUP, STRK, CNTRCT, MFY, and PMALES. The problem here, however, is that the resulting index may lead to compensation for unidentified factors and special circumstances for which compensation (or reduction of funds) is not justifiable in terms of our basic objective of equalizing the capacity of each school district's dollar to purchase inputs.

In Table 3 we show, in column (1), the ratio $\frac{ATS_i}{\overline{ATS}}$, simply to indicate the relation between the average salaries in each of the districts and the mean

Table 3. Adjustment Indices for Teachers' Salaries, Sample of 173 Michigan K-12 School Districts

District	Type of District	(1) $\frac{ATS_i}{ATS}$	(2) AITS
Adrian	IND	.991	1.014
Airport Community	RUR	.927	.895
Allegan	IND	.815	.938
Allen Park	SUB	1.184	1.092
Alpena	IND	1.101	1.014
Ann Arbor	CE	1.325	1.076
Au-Grea-Sima	RUR	.722	.835
Bark River-Harris	RUR	1.009	.947
Battle Creek	CE	1.101	1.027
Bay City	CE	1.143	1.140
Bear Lake	RUR	.895	.829
Bedford	RUR	.966	.974
Beecher	SUB	1.010	1.013
Bellevue Community	SUB	.841	.909
Benton Harbor	IND	1.008	1.023
Berkley	SUB	1.045	1.102
Birmingham	SUB	1.210	1.062
Bloomfield Hills	SUB	1.188	1.029
Brandon Twp.	SUB	.831	.919
Brandywine	RUR	.863	.894
Bridgeport Community	SUB	.883	.952
Brimley	RUR	.937	.769
Bullock Creek	RUR	.726	.887
Byron Community	SUB	.886	.907
Caledonia Community	SUB	.943	.928
Carman	SUB	1.110	.987
Center Line	SUB	1.186	1.059
Cheboygan	IND	.975	1.005
Cherry Hill	SUB	1.064	1.034
Cheaaning Union	SUB	.949	.966
Chippewa Valley	SUB	.890	.943
Clarenceville	SUB	1.090	.934
Clarkston Community	SUB	.938	.995
Clawson	SUB	.997	.968
Clintondale	SUB	1.029	1.029
Clio Area	SUB	.909	.936
Coldwater	IND	.843	.931
Colon Community	RUR	.775	.896
Conatantine	RUR	.870	.896
Corunna	RUR	.880	.914
Creatwood	SUB	.938	1.014
Forest Park	RUR	.922	1.014
Davison Community	SUB	.973	.943
Dearborn	SUB	1.221	1.275
Dearborn Heights	SUB	1.043	1.019
Westwood Community	SUB	1.155	1.039
Deckerville	RUR	.846	.927
Dalton-Kellogg	RUR	.883	.899
Detroit	CE	1.087	1.274
Dowagiac Union	IND	.876	.966
Dundee Community	RUR	.915	.930
E. China Township	RUR	.969	.998
E. Detroit	SUB	1.072	1.089
E. Jackson County	SUB	.899	1.023
E. Lansing	CE	.909	1.030
Eaton Rapids	SUB	.906	.940
Ecorse	SUB	1.308	1.235
Escanaba	IND	.954	1.028
Farmington	SUB	1.111	1.014
Ferndale	SUB	1.140	1.104
Fitzgerald	SUB	1.124	1.116
Flint	CE	1.116	1.143
Flushing Community	SUB	.915	.893
Forest Hills	SUB	.934	.930
Fraser	SUB	.941	.993
Garden City	SUB	1.078	1.115
Gibraltar	SUB	.941	.976
Grand Blanc	SUB	.977	.944
Grand Haven	SUB	1.071	1.019
Grand Ledge	SUB	1.001	.898
Grand Rapids	CE	1.080	1.048
Harbor Springs	RUR	.949	.893
Harper Creek	SUB	.924	.994
Hazel Park	SUB	1.204	1.172
Highland Park	SUB	1.042	1.060
Holland	SUB	.957	1.042
Holton	SUB	.868	.893
Howell	SUB	.925	.951
Huron	SUB	.952	1.053
Huron Valley	SUB	1.067	1.006
Inkater	SUB	1.032	1.129
Iron Mountain	IND	1.017	1.015
Jackson Union	CE	1.190	1.140
Kalamazoo	CE	1.188	1.127
Kearsley Community	SUB	1.027	.984
Kentwood	SUB	.905	.900
Kingsley Area	RUR	.738	.818
Lake Fenton	SUB	.855	.874
Lake Orion Community	SUB	.983	.985
Lakeview (Calhoun Co.)	SUB	1.123	1.023
Lamphere	SUB	1.106	1.009
Lansing	CE	1.142	1.136
Lapeer	SUB	.907	.967
Lincoln Park	SUB	1.128	1.234
Litchfield Community	RUR	.823	.824
Livonia	SUB	1.233	1.053

Continued

Table 3. Adjustment Indices for Teachers' Salaries, Sample of 173 Michigan K-12 School Districts

District	Type of District	(1) $\frac{ATS_i}{ATS}$	(2) AITS
L'Anse-Creuse	SUB	.975	.985
Luddington Ares	RUR	1.019	.935
Msdison Heights	SUB	1.006	1.023
Mancelons	RUR	.889	.956
Manistee	IND	.950	.991
Marquette	IND	.940	.963
Marshall	SUB	1.046	.951
Melvindale-N.Allen Psrk	SUB	1.162	1.169
Mendon Community	RUR	.731	.797
Menominee	IND	.974	1.000
Merrill Community	SUB	.946	.945
Michigan Center	SUB	.998	.985
Midland	IND	1.094	1.045
Mona Shores	SUB	.998	1.021
Monroe	IND	1.020	1.045
Mt. Clemens Community	SUB	1.155	1.081
Mt. Pleasant	IND	1.102	.998
Munising	IND	.906	.921
Muskegon	CE	.929	1.056
Niles	IND	.897	1.026
Osk Park	SUB	1.362	1.122
Orchard View	SUB	.974	1.045
Oscods Area	RUR	.925	.887
Otsego	RUR	.852	.902
Owosso	IND	1.092	1.006
Peck Community	RUR	.785	.771
Petoskey	IND	.950	.943
Plymouth Community	SUB	1.092	1.064
Pontiac	CE[a]	1.149	1.186
Port Huron	IND	.986	1.031
Portage Township	RUR	.755	.767
Portage Township (Kalamazoo Co.)	SUB	.964	1.011
Rspid River	RUR	.816	.854
Redford Union	SUB	1.166	1.097
Reeths Puffer	SUB	.904	.941
River Rouge	SUB	1.300	1.218
Riverview Community	SUB	.975	1.044
Rochester Community	SUB	1.086	1.031
Rogers Union	IND	.985	1.006
Romeo Community	SUB	1.004	1.006
Romulus Community	SUB	1.028	1.094
Roseville	SUB	1.196	1.121
Roysl Oak	SUB	1.086	1.067
Saginaw	CE	1.119	1.136
Saginsw Twp. Comm'ty.	SUB	.992	.947
Sault Ste. Marie	IND	.923	.904
Shelby	RUR	.855	.889
South Lake	SUB	1.090	1.060
South Redford	SUB	1.188	1.136
Southfield	SUB	.974	1.002
Southgate Community	SUB	1.139	1.085
Spring Lske	SUB	1.025	.966
St. Charles Community	SUB	.851	.882
St. John's	SUB	.955	.943
St. Joseph	IND	1.070	1.043
Swan Valley	SUB	.826	.871
Swsrtz Creek Comm'ty.	SUB	.990	.954
Taylor	SUB	1.185	1.151
Tecumseh	RUR	1.029	.982
Three Rivers	IND	.932	.939
Trsverse City	IND	.921	.977
Trenton	SUB	1.213	1.062
Troy	SUB	1.074	.955
Utica Community	SUB	.957	1.019
Van Dyke Community	SUB	1.141	1.090
Vassar	RUR	.899	.945
Walled Lske Cons.	SUB	1.060	1.041
Warren Cons.	SUB	.973	1.034
Waterford Twp.	SUB	1.090	1.052
Waverly	SUB	.914	.990
Wayne Community	SUB	1.157	1.112
W. Bloomfield Twp.	SUB	.942	.954
White Cloud	RUR	.784	.809
Willow Run	SUB	.909	.976
Wyandotte	SUB	1.148	1.165
Wyoming	SUB	.961	.972
Ypsilsnti	CE[a]	1.083	1.080

[a]Nominally "suburb" but here classified as s central city because although not the largest city in the SMSA, it aeems to us to be more characteristic of central cities than of suburba.

AITS for the sample districts. It is of interest as an indicator of actual differences among school districts in salaries paid to teachers, especially in connection with policy proposals that suggest providing each district with funds sufficient to permit the employment of a given number of teachers per 1,000 pupils. In the second column we present the adjustment index for teachers' salaries (AITS) for these districts, calculated from equation (8) above.

The values for AITS center on a mean of 1.000, with a standard deviation of .095. They all lie within a range of .767 at the bottom to a high of 1.275. School districts at the low end of the scale are, in general, small, sparsely populated, rural, and, with disproportionate frequency, located in the Upper Peninsula. At the high end we find Detroit, accompanied by such older but diverse suburbs as Dearborn, Ecorse, Lincoln Park, and River Rouge. They are diverse in many ways, but most obviously in terms of the fact that Ecorse and River Rouge are industrial enclaves with very high SEVP and low-income residents,[1] Dearborn has both high SEVP and high MFY, while Lincoln Park's SEVP is substantially below and its MFY only modestly above the average.

Noting that Dearborn would fare as well as Detroit with respect to compensation, and that such affluent suburbs as Berkley and Birmingham have AITS's that exceed 1 is likely to raise questions about the efficacy of the cost adjustment index for teachers' salaries. These questions may stem from concern for "equity", for "equality of opportunity", for the "plight of the central city", and so forth, all of which are worthy concerns. None, however, is an immediate, direct objective of the construction and application of the AITS. The latter, rather, is designed simply to compensate school districts that confront conditions that

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[1] MFY of approximately $10,000, compared with a mean for all districts in the sample of $12,275.

require paying higher salaries for teachers (of a like quality) than districts facing more favorable conditions and able to hire their teachers with less money.

The value of the AITS exceeds 1 for all central city school districts in the State and falls below 1 for all but one rural district. Independent city and suburban school districts, on the other hand, exhibit little consistency, some of them having index values above and some below 1. This is the picture that one might easily have predicted, but it is not one that is, in any normative sense, "good" or "bad". Programs to ease the fiscal problems of central city districts, to ensure equal availability of inputs, or to recognize and help districts to meet special needs, are complementary to one that has as its objective merely the equalization of the ability to acquire inputs (in the present context, teachers) with any given amount of dollars.

Teachers and other instructional salaries account for approximately 70 per cent of school district current operating expenditures. We turn now to the problem of developing an index for operating expenditures other than teachers' salaries.

OTHER OPERATING EXPENDITURES

For all school districts in Michigan the 1972-73 percentage breakdown of total current expenditures of $2,085 million, or $951 per pupil, was as follows:[1]

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[1]Derived from Michigan Department of Education, Analysis of Michigan Public School Revenues and Expenditures, 1972-73, Bulletin 1011 (n.p., n.d.), p. 15.

Instructional expenditures			74.72
Salaries		70.23	
Non-salary		4.49	
Non-instructional expenditures			25.28
Administration		3.58	
Salaries	2.80		
Non-salary	.78		
Attendance and Health Services		.52	
Salaries	.47		
Non-salary	.05		
Transportation		3.78	
Salaries	2.11		
Non-salary	1.67		
Plant maintenance and operation		13.14	
Salaries	7.55		
Non-salary	5.59		
Fixed charges		4.26	
Total Current Expenditures			100.00

Each of these categories of expenditures is largely self-explanatory except for "fixed charges". These are defined in a way that few economists or business accountants would expect, as "expenditures of a generally recurrent nature which are not readily allocable to other expenditure accounts such as insurance payments and interest paid on short-term loans."[1]

Instructional expenditures, comprising almost 75 per cent of total current expenditures, are made up, for the most part, of salaries paid to "teachers and other professional staff who assist directly in the educational process."[2] Classroom teachers account for some 55 percent, while principals, assistant principals, counsellors, various specialists, and so forth, make up the remaining 70 per cent of the instructional salary share of current outlays.

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[1] Ibid, p. 3.

[2] Ibid, p. 2.

Most of the latter (generally excluding principals) are typically covered under the same union contract as are the classroom teachers and the few who are not can be assumed to receive salaries that bear about the same relation to teachers' salaries in each of the districts. Thus the cost adjustment index for teachers' salaries (AITS) can reasonably be expected to be applicable to the broader category of instructional materials.

The non-salary portion of instructional expenditure consists of classroom supplies, books, and related instructional materials. Michigan law prohibits price discrimination among districts with respect to texts, and this fact together with the relatively small size of this category, just under 4.5 per cent of current expenditures, suggests that no appreciable damage is likely to be wrought if it is assumed that the appropriate index value applicable to all districts for this portion of current expenditures is 1.

NON-INSTRUCTIONAL EXPENDITURES

The remaining 25.28 per cent of current expenditures is a composite called "non-instructional expenditures", made up of salary and non-salary outlays for administration, attendance, health services, transportation, operation and maintenance of plant, and "fixed charges", in the proportions indicated in the tabulation presented above. There are so many diverse kinds of personnel and other inputs involved that an approach to the estimation of indices such as AITS would require a large number of models and their estimation would take far more time and money than the detailed results could possibly warrant. Moreover, much of the data that would be needed would have to be collected de novo from the individual school districts, many of which would be unable to supply it. Thus, given the very broad composite of different kinds of input purchases that make up non-instructional expenditures per pupil

(NIXCP), it does not seem feasible to attempt to identify explicit demand and supply functions, either for each of its major components or for NIXCP in the aggregate.

This is not to say, however, that we cannot construct a cost adjustment index for NIXCP.

We do not have a formal model explaining why NIXCP is high in some school districts and low in others, why it ranges from $500 to a low of only $176, with a mean of $278. But we do believe we have a set of hypotheses relating variance in NIXCP to a number of characteristics of communities, school systems, and children which, taken together, "explain", both in a logical and in a statistical sense, a large proportion of that variance, large enough to permit the construction of an adjustment index for NIXCP. Thus we stipulate at the outset that

$$NIXCP = f(K, R, P), \tag{9}$$

where K, R, and P are vectors of the three indicated groups of characteristics.

Hypotheses Underlying the Analysis

Characteristics of the community are given by MILLV, representative of its willingness to support the educational program, with the size of its tax base and other factors taken into account; SEVP, our measure of ability to support the program, as indicated by tax base available per pupil; MOB; location in the central city, suburb, rural community, or independent city; non-school local demands upon taxpayers as represented in TAXO; regional location within the State; PCHPOV, the proportion of all children who lived in families with 1969 incomes of less than $3,000; and the opportunity cost of working for the school system as a non-professional, measured by TCOST, the average annual earnings in the county in 1969 of all female clerical and kindred workers aged 16

and over.

In general our hypotheses regarding the level of NIXCP and the foregoing list of community characteristics are clear. We expect higher MILLV to be reflected in higher educational expenditures in general, including the roughly one-quarter accounted for by NIXCP. Similarly, other things being equal, NIXCP should rise with increases in SEVP.

An increasingly costly element of non-instructional expenditures consists of outlays for security and repairing of damages wrought by vandals. It is frequently observed that such costs tend to be especially high in the larger central cities, where the proportion of the children in the district who are culturally or educationally deprived is high. Thus it is our hypothesis that NIXCP is positively associated with location of the district in a central city (CE) and with PCHPOV.

To the extent that regional location in the State plays a role in influencing the level of NIXCP it may do so through the fact that sparsely populated areas spend more per pupil for transportation. Thus we expect location in the Upper Peninsula and the northern part of the Lower Peninsula to be associated with a higher level of NIXCP than the Detroit SMSA or the districts found in the more southerly tiers of counties outside of Metro Detroit.[1]

The more stable the residents of the district (MOB), the less would we expect to find the district spending for NIXCP. Population stability implies

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[1] The latter serve as our "control group", with districts taking on a value of 1 if in the U.P., 0 otherwise; 1 if in the Detroit SMSA, 0 otherwise; and 1 if in the northern half of the Lower Peninsula, and 0 otherwise. The estimated coefficients on each of these three dummy variables will, then, indicate the estimated difference in NIXCP attributable to a district not being located in the "control" region.

to us both close acquaintance with and interest in local schools, less vandalism, perhaps a sharper eye on administrative extravagance, and, in general, a downward influence on NIXCP.

TAXO, the "municipal overburden" argument, may again be appropriately tested. If it is valid higher non-school taxes should lead to lower levels of NIXCP. It seems reasonable to expect that non-school municipal services may be seen as rival in consumption to school services, such as the quality and quantity of plant maintenance, transportation, and health services.

Other things being equal, the higher the earnings available to non-teachers in the local labor market in employment outside the school system, the higher will be the wage rates the schools must pay to attract their non-instructional personnel. Our measure of this opportunity cost of employment by the school district is TCOST, and we expect that NIXCP is positively associated with it.

We have far fewer variables to represent local school system characteristics. They are the logarithm of the number of teaching positions in the system (LTEAC), our measure of size of the district; militancy of the teachers' union, STRK, and the strength of the teachers' union as indicated by CNTRCT, whether or not the union contract calls for both an agency shop and binding arbitration.

Larger school districts tend to be in urban locations where transportation costs are less and fewer children are transported. They may also enjoy some economies of scale and may be able to obtain lower utility rates. But if such reductions in elements of NIXCP occur with increasing size of the district, we expect that the rate of decline falls off quite rapidly rather

than maintaining a constant pace. Thus, our hypothesis is that the relationship is best approximated by stating size in terms of the logarithm of the number of teaching positions, so that a change of 1 in LTEAC signals a tenfold increase or decrease in the number of teachers.[1]

Because teachers and other professionals are generally not represented by the same union as those whose salaries and wages enter NIXCP, a strong, militant teachers' union local may make its gains on behalf of teachers at the expense of other employees. If this is so we should, of course, expect to find a negative association between STRK and CNTRCT on the one hand and NIXCP on the other. An alternative hypothesis that may be as intuitively appealing, however, is that non-teachers may "ride the coat tails" of strong, militant teachers' unions and the relationship may well tend to be positive rather than negative. We are not aware that either of these hypotheses has been extensively tested elsewhere, and we have no firm basis for either side of the argument.

For relevant characteristics of the students, apart from the proportion living in poverty, we have only LPMIN, the log of the percentage of the public school pupils in the district who are either black or carry Spanish surnames. Our hypothesis here is that NIXCP increases with LPMIN, suggesting that as the proportion of minority students increases their impact on the level of NIXCP increases, but at a rapidly diminishing rate. In part this reflects a racial conflict hypothesis, one that asserts that it may take an increase in minority enrollment from, for example, 5 to over 25 per cent to double its impact on the

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[1]For example, if the number of teachers increases from 30 to 300 LTEAC rises from 1.48 to 2.48.

level of NIXCP.[1]

Regression Results

The foregoing set of hypotheses suggests estimation of the following equation:

$$\begin{aligned} NIXCP = e &+ f_1 MILLV - f_2 LTEAC + f_3 SEVP + f_4 LPMIN \\ &+ f_5 PCHPOV - f_6 MOB + f_7 CE - f_8 RUR - f_9 SUB + f_{10} UP \\ &- f_{11} METRO - f_{12} CENT + f_{13} TCOST - f_{14} TAXO - f_{15} STRK \\ &- f_{16} CNTRCT + \omega, \end{aligned} \tag{10}$$

where e is the constant term, the f_i's are the regression coefficients, and ω is the error term. The signs shown are those indicated by our hypotheses.

Using ordinary least squares we obtained the estimating equation presented in Table 4. The predictor variables account for about two-thirds of the variance among the 173 school districts in the sample NIXCP, and all but RUR, SUB, the regional dummies, and STRK carry regression coefficients that are statistically significant at the .10 level or better. Moreover, the signs attached to each of the coefficients that differ significantly from zero are those suggested by our hypotheses.[2]

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[1] That is, an increase in LPMIN from .70 to 1.40.

[2] The interpretation of the regression coefficients is quite straightforward. For example, adding 1 to the log of the number of teachers reduces NIXCP by $25, and location of the school in a central city rather than in an independent city increases it by almost $27, roughly 10 per cent of the mean value of NIXCP for the sample.

Once more the municipal overburden hypothesis is not supported; the coefficient on TAXO, while negative in sign, does not depart appreciably or significantly from zero.

Adjustment Index for NIXCP

In order to compensate for high or offset lower costs for NIXCP we may simply adapt the methodology used for teachers' salaries and set forth in expression (7). The adjustment index for NIXCP, AINIX, is

$$AINIX_i = \frac{\overline{NIXCP} + \sum_{j=1}^{n} f_j(Z_{ij} - \overline{Z}_j)}{\overline{NIXCP}}, \qquad (11)$$

where $\overline{NIXCP}$ is the mean value for all districts in the sample for NIXCP, the f_j's are the regression coefficients from (10) to be included in the computation of the index, Z_{ij} is the observed value in the i^{th} district for the j^{th} variable, and $\overline{Z}_j$ is the sample-wide mean for that variable.

In choosing the variables to be entered into the calculation of AINIX we first exclude those that represent tastes or preferences and taxable wealth, MILLV and SEVP. And because they cannot appreciably affect the values of the resulting indices, we omit those for which the true values of the regression coefficients may well be zero, such as RUR, SUB, and TAXO. We retain STRK and CNTRCT because these variables refer to teachers' activities and union strength and their impact on NIXCP cannot be said to be of a self-serving nature; from the standpoint of variance in NIXCP we argue that these variables are essentially exogenous.

Table 4. Regression Results, Non-Instructional Expenditures per Pupil in 173 K-12 School Districts, 1972-73

Predictor Variables	Regression Coefficient	Standard Error	't' Statistics	Mean (unweighted)	
Conatant	156.8 ***	48.50	3.23	---	
MILLV	5.242 ***	.6604	7.94	16.32	
LTEAC	-25.01 **	10.02	-2.50	2.338	
SEVP	.0033***	.0003	11.0	20.249	
LPMIN	13.03 *	7.006	1.86	.4534	
PCHPOV	2.373 **	1.174	2.02	4.479	
MOB	-1.066 ***	.3117	-3.42	55.78	
CE	26.88 *	14.48	1.86	---	.0800
RUR	1.695	10.68	.159	---	.1829
SUB	-5.636	10.38	-.543	---	.5943
UP	13.76	13.64	1.01	---	.0629
METRO	-10.50	9.647	-1.09	---	.3829
CENT	-11.50	10.64	-1.08	---	.1143
TCOST	.0192**	.0086	2.23	4.241	
TAXO	-.0801	.4363	-.184	22.78	
STRK	.9491[a]	.6059	1.57	1.577	
CNTRCT	-10.08 *	5.855	-1.72	---	.6177
			NIXCP	278.2	

R^2 = .66
S.E. = 33.14
σ = 53.99
N = 173

*significant at p < .10
**significant at p < .05
***significant at p < .01

[a]significant at p = .12

Thus the adjustment index for NIXCP for each district is given by the following equation:

$$\begin{aligned} AINIX_i = 278.2 &- 25.01\ (LTEAC_i - 2.338) + 13.03\ (LPMIN_i - .4534) \\ &+ 26.88\ (CE_i - .0800) - 1.066\ (MOB_i - 55.78) \\ &+ 2.373\ (PCHPOV_i - 4.479) + .0192\ (TCOST_i - 4.241) \\ &+ .9491\ (STRK_i - 1.577) - 10.08\ (CNTRCT_i - .6171) \\ &+ 13.67\ (UP_i - .0629) - 10.50\ (METRO_i - .3829) \\ &- 11.50\ (CENT_i - .1143) \end{aligned} \Big/ 278.2 \qquad (12)$$

The resulting adjustment indices are shown for each of the school districts in our sample in column (2) of Table 5. Their range, while considerably narrower than that of the ratio of $NIXCP_i$ to $\overline{NIXCP}$ (column (1)), runs from .863 for Livonia and Mt. Pleasant, Detroit suburb and independent city home of Central Michigan University, respectively, to Highland Park at 1.240 and East Lansing at 1.230. These indices do not seem to follow a strikingly obvious pattern. Central cities generally appear to have values for AINIX exceeding 1, but so do many rural districts. The diversity of kinds of expenditures that make up NIXCP is such as to ensure that this kind of result would emerge.

AN OVERALL COST ADJUSTMENT INDEX

The estimated cost adjustment indices, AITS and AINIX, may be employed separately or, if preferred, they may be merged as our overall means of adjusting school revenues for differences in prices or costs of all elements of total current operating expenditures. Combination of the two simply requires weighting each according to its share of the district's current budget, applying AITS

to total instruction expenditures, and AINIX to non-instructional expenditures.

To see how this approach would apply, we may examine the circumstances of the Detroit school district. In 1972-73 total instruction expenditure per pupil of $752.42 comprised 75.2 per cent and NIXCP 24.8 per cent of current operating expenditures. The district's AITS is 1.274 and its AINIX is 1.096. Using budget proportions as weights, we obtain .752(1.274) + .248(1.096) = 1.230 as the overall cost adjustment index for Detroit. A contrasting illustration would be the case of the Peck Community district of rural Sanilac county. Its AITS is .771 and its AINX is 1.051. The overall index for this district is given by .702(.771) + .298(1.051) = .854.

In application the cost adjustment index may be used by the State either to adjust state aid only or as a means of supplementing (or reducing) the amount of revenue otherwise available from all sources. Thus, for example, if used in the latter fashion, for 1972-73 Detroit would have received a supplementary payment from the State of (1.230-1)(1000.75) = $230.17 per pupil, whereas Peck Community School district would have realized a reduction in funds received from the State of (.854 - 1)(719.23) = $-105.01.[1]

Concluding Comments

This extension of our earlier paper clearly does not meet all objections to nor does it answer all the questions raised by that paper. Its methodology is, we believe, more satisfactory, although it falls substantially short of

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[1] Data on Total Current Operating Expenditures and Total Instructional Expenditures per pupil are given in State of Michigan, Department of Education, Ranking of Michigan Public High School Districts by Selected Financial Data, 1972-73, Bulletin 1012 (n.p., n.d.).

Table 5. Adjuatment Indices for Non-Instructional Expenditutes per Pupil, Sample of 173 Michigan K-12 School Districts

District	$\frac{NIXCP_i}{NIXCP}$	AINIX	District	$\frac{NIXCP_i}{NIXCP}$	AINIX
Adrian	.945	1.028	Detroit	1.024	1.096
Airport Community	.920	1.018	Dowagiac Union	1.085	1.075
Allegan	.791	.990	Dundee Community	.726	1.004
Allen Park	.927	.891	E. China Township	.974	.899
Alpena	1.003	.915	E. Detroit	.877	.865
Ann Arbor	1.179	1.152	E. Jackson County	.884	1.064
Au-Gres-Sims	1.064	1.136	E. Lansing	1.707	1.230
Bark River-Harris	1.089	1.116	Eaton Rapids	.949	1.087
Battle Creek	1.510	1.183	Ecorse	1.190	1.125
Bay City	.830	.978	Escanaba	.816	1.003
Bear Lake	.916	1.017	Farmington	.981	.933
Bedford	1.017	.909	Ferndale	.906	.961
Beecher	.938	1.109	Fitzgerald	1.164	.922
Bellevue Community	1.046	1.025	Flint	1.118	1.116
Benton Harbor	1.085	1.094	Flushing Community	.769	1.022
Berkley	.945	.888	Forest Hills	.823	.945
Birmingham	1.247	.903	Fraser	.938	.945
Bloomfield Hills	1.495	1.014	Garden City	.715	.883
Brandon Twp.	.981	1.054	Gibraltar	.963	.980
Brandywine	.981	.990	Grand Blanc	.852	.978
Bridgeport Community	.952	.972	Grand Haven	.888	.916
Brimley	1.078	1.217	Grand Ledge	.884	.983
Bullock Creek	.920	.961	Grand Rapids	1.330	1.067
Byron Community	.992	.985	Harbor Springs	.985	1.071
Caledonia Community	.999	.967	Harper Creek	.906	.978
Carman	1.236	.984	Hazel Park	.913	.946
Center Line	.845	.897	Highland Park	1.531	1.240
Cheboygan	.887	1.022	Holland	.823	.954
Cherry Hill	.794	.979	Holton	.906	1.045
Chesaning Union	.841	.962	Howell	.996	1.007
Chippewa Valley	1.121	1.009	Huron	.916	1.010
Clarenceville	1.200	.959	Huron Valley	1.146	1.000
Clarkston Community	.812	1.021	Inkster	1.121	1.169
Clawson	.834	.973	Iron Mountain	.780	.969
Clintondale	1.118	1.040	Jackson Union	1.355	1.083
Clio Area	.668	.959	Kalamazoo	1.520	1.162
Coldwater	.970	.949	Kearsley Community	.704	.941
Colon Community	.963	1.097	Kentwood	1.021	1.009
Constantine	1.204	1.003	Kingsley Area	.895	1.058
Corunna	.852	.970	Lake Fenton	.978	1.003
Crestwood	.852	.919	Lake Orion Community	.945	.955
Forest Park	1.050	.933	Lakeview (Calhoun Co.)	.913	.972
Davison Community	.834	.960	Lamphere	1.233	.971
Dearborn	1.797	.905	Lansing	1.190	1.110
Dearborn Heights	.733	.955	Lapeer	.827	.940
Westwood Community	1.164	1.109	Lincoln Park	.780	.905
Deckerville	.877	1.041	Litchfield Community	.866	1.028
Dalton-Kellogg	.769	1.025	Livonia	.913	.863

Continued

Table 5. Adjustment Indices for Non-Instruction Expenditures per Pupil, Sample of 173 Michigan K-12 School Districts

District	$\frac{NIXCP_i}{\overline{NIXCP}}$	AINIX
L'Anse-Creuse	1.042	.987
Luddington Area	.762	.906
Madison Heights	.931	.983
Mancelona	.999	.994
Manistee	.819	.911
Marquette	1.017	1.030
Marshall	1.172	1.022
Melvindale-N.Allen Park	.945	.969
Mendon Community	.956	1.120
Menominee	.931	.993
Merrill Community	.895	.995
Michigan Center	.924	.966
Midland	.970	.896
Mona Shores	.873	.957
Monroe	1.085	.935
Mt. Clemens Community	1.096	1.035
Mt. Pleasant	1.121	.863
Munising	.791	.983
Muskegon	1.172	1.118
Niles	1.060	.985
Oak Park	1.495	1.024
Orchard View	.791	.990
Oscoda Area	.866	1.084
Otsego	.902	1.041
Owosso	.737	.980
Peck Community	.877	1.051
Petoskey	1.107	.933
Plymouth Community	1.182	.976
Pontiac	1.197	1.143
Port Huron	.848	.945
Portage Township	.859	1.123
Portage Township (Kalamazoo Co.)	.866	.944
Rapid River	1.071	1.221
Redford Union	.949	.875
Reeths Puffer	.780	1.014
River Rouge	1.783	1.131
Riverview Community	1.190	.973
Rochester Community	.916	.948
Rogers Union	.974	.923
Romeo Community	1.003	1.074
Romulus Community	1.218	1.059
Roseville	.704	.918
Royal Oak	1.024	.927
Saginaw	.934	1.100
Saginaw Twp. Comm'ty.	1.111	.935
Sault Ste. Marie	.963	1.057
Shelby	.841	.938
South Lake	1.053	.897
South Redford	1.057	.873
Southfield	1.222	.951
Southgate Community	.978	.907
Spring Lake	.913	.945
St. Charles Community	.834	1.012
St. John's	.999	.979
St. Joseph	1.168	.925
Swan Valley	.632	1.034
Swartz Creek Comm'ty.	.776	1.017
Taylor	1.024	.987
Tecumseh	.981	1.001
Three Rivers	.934	1.008
Traverse City	1.028	.929
Trenton	1.024	.955
Troy	.952	1.000
Utica Community	.967	.930
Van Dyke Community	1.222	.958
Vassar	.784	1.086
Walled Lake Cons.	1.024	.950
Warren Cons.	.967	.945
Waterford Twp.	1.035	.932
Waverly	1.179	1.054
Wayne Community	1.118	.907
W. Bloomfield Twp.	1.211	.974
White Cloud	.920	1.053
Willow Run	1.208	1.052
Wyandotte	1.110	.963
Wyoming	1.017	.923
Ypsilanti	.884	1.164

spelling out and applying a fully satisfactory model of the market for public school teachers or the behavior of non-instructional expenditures. We have gathered data on some 30 additional potential predictor variables, some of which appear to be obviously useful while others proved wholly useless. Perhaps our largest gap remains the paucity of useable data on the quality of teachers. That gap is a consequence not merely of data problems as such, however; rather, it exists at least as much because until we know more about the education production function it remains impossible even to define, let alone measure, teacher quality.

Objections may be anticipated on several grounds. The most obvious may be directed toward the idea that a cost adjustment index is simply not an appropriate part of a "good" system of school finance. If this position is maintained because the adjustment index fails to shift funds in a manner that gets more money into the observer's "target" districts, the response must be that it is not designed to compensate for the problems of the inner city, it is not designed to equalize revenues or compensate for "special" needs. It is designed, rather, to compensate, positively or negatively, for price or cost differences, and it is inappropriate to object to it (or anything else, for that matter) because it fails to achieve that which it was not intended to achieve.

A more important objection[1] rests on the premise that the price system serves its purpose well when it encourages people or institutions to economize on the use of relatively high priced items and substitute those carrying relatively low prices. Thus if teachers' salaries in a district are high, the incentive to substitute other inputs and thus increase budgetary and economic

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[1] Raised by Professor R. Barlow.

efficiency of the school system may be damped if the district receives a compensatory adjustment from the State. We accept the essence of this argument, but counter that it is very much reduced in force if there are in fact no close substitutes for teachers as inputs and if, instead of applying only the AITS, we employ the comprehensive index made up of the weighted combination of AITS and AINIX.

Finally, of course, one may well question several aspects of our analysis and results. We are left with substantial unexplained variance in our dependent variables. Is it so large as to make the results too unreliable to be useful? We think not, but this is clearly a matter of subjective judgment. And there remain, as there undoubtedly must, differences of opinion with respect to methodological details. Are AYTE and PTECM really exogenous variables, does their inclusion as such give rise to undesired incentives on the part of school district management? Possibly.

One other problem remains. We choose to mention it to give notice that we are not unaware of its existence. Is it politically feasible to incorporate cost adjustment indices in school finance systems? On this, and as our last word, we defer to other specialists.

Appendix A

Definitions of Variables and Sources of Data

ATS	Average teachers' salaries. Michigan Department of Education, Ranking of Michigan Public High School Districts by Selected Financial Data, 1972-73, Bulletin 1012. (Lansing, n.d.). Hereinafter cited as Bulletin 1012.
NIXCP	Difference between "current operating expenditure" and "total instruction expenditure" per pupil. Bulletin 1012.
AYTE	Average years of teaching experience. Michigan Department of Education, Local District Results, The Fourth Report of the 1971-72 Michigan Educational Assessment Program (Lansing, 1972). Hereinafter cited as Local District Results.
CE	Dummy variable, 1 if the district is located in the central city of a Standard Metropolitan Statistical Area, as defined by the 1970 Census of Population, and the City of Pontiac, 0 otherwise.
CENT	Dummy variable, 1 if district is located in the northern part of the Lower Peninsula, 0 otherwise.
CNTRCT	Dummy variable, 1 if district operates under union contract calling for agency shop and binding arbitration, 0 otherwise. Summary of Salary Schedules and Other Selected Contract Provisions, 1973-74 (East Lansing: Michigan Education Association, 1974).
DENS	Population per square mile of the county in which the school district is located. U. S. Department of Commerce, Bureau of the Census, County and City Data Book, 1972 (Washington, D. C.: U.S. Government Printing Office, 1973).
INDC	Districts other than those classified as CE, SUB, or RUR.
LPMIN	Common logarithm of the percentage that black and Spanish surname pupils comprise of the total enrollment in the school district. National Center for Educational Statistics, U.S. Office of Education, Combined SDDT-ELSEGIS III (SDEL 3) Data Tapes, Michigan Tape. Hereinafter cited as SDEL 3.

LPUP	Logarithm of number of pupils. From Bulletin 1012.
LTEAC	Common logarithm of the number of teaching positions in the school district. Michigan Department of Education, 1972-73 Summary of Expenditure Data for Michigan Public Schools, Bulletin 1013 (n. p., n.d.). Herinafter cited as Bulletin 1013.
METRO	Dummy variable, 1 if school district is in Detroit S.M.S.A., 0 otherwise.
MILLV	Number of extra-voted mills approved by electorate of the school district for operations. Bulletin 1012.
MLEMP	Average yearly earnings of all male employees aged 16 and over in the county in 1969. Census of Population, 1970, Vol. I, Pt. 24.
MOB	Proportion of population in the school district aged 5 and over who lived in the same house in 1970 as in 1965. SDEL 3
MFY	Median family income in the school district in 1969. SDEL 3.
PCHPOV	Proportion of children aged 5-17 in families with income of less than $3,000. SDEL 3.
PCOL	Proportion of the adult population with one or more years of college. SDEL 3.
PFOR	Proportion of the population not born in the United States or whose parents were not born in the United States. SDEL 3.
PMALES	Percentage of teachers in the district who are male. Michigan Department of Education, Professional Personnel Register, 1972-73, Tape.
PNW	Proportion of the population black or Negro and Spanish surname. SDEL 3.
PPUPOP	K-12 enrollment in the public schools as a proportion of the total population. SDEL 3.
PRICH	Proportion of families with income in 1969 of $15,000 and over. SDEL 3.
PTECM	Proportion of teachers in the school district with M.A. degree. Local District Results.
RES	Proportion of taxable value of property real

	residential in major municipality in the school district in 1968. The value for the county used where municipal or township data not available. A.P. Snyder and J. Lepczyk, 1968 Value of Taxable Property in Michigan (East Lansing: Institute for Community Development and Services, Michigan State University, 1969).
REVPL	Revenue from local sources as percent of total general revenue. Bulletin 1012.
SEVP	State equalized value of property per pupil. This is the effective local tax base per pupil. Bulletin 1012.
SKCF	Basic skills composite achievement test scores for fourth grade pupils in the district. Local District Results.
STRK	Number of days teachers were on strike in the district, 1970 to 1972. Data derived from Michigan Education Association, Michigan Teacher Strikes, 1966-1974 (mimeo), and Michgan Employment Relations Commission, Public Employment Bi-Weekly Work Stoppage Report, 1970-1972.
TAXO	1973 total local non-school tax rate, including millage equivalents of municpal income taxes. Derived from data supplied by Michigan Department of the Treasury, State Tax Commission.
TCOST	Average yearly earnings of all female employees aged 16 and over in the county in 1969. Census of Population, 1970, Vol. I, Pt. 24.
TPUP	Teachers per pupil. Derived from Bulletins 1012 and 1013.
UP	Dummy variable, 1 if district is located in the Upper Peninsula, 0 otherwise.

CONSTRUCTING TEACHER COST INDICES: METHODOLOGICAL EXPLORATIONS WITH CALIFORNIA UNIFIED SCHOOL DISTRICTS*

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I. Introduction

Because of legal and legislative attacks over the past twenty years, the issue of equity in public schooling has received considerable public scrutiny. In the course of debate, our understanding of the issues involved has become more sophisticated: we are now conscious that inequalities extend to almost every aspect of schooling, and we can identify patterns of racial, ethnic, class, and sexual bias running through various kinds of inequitable treatment. Among the topics which have been highlighted are patterns of segregation, the effects of family background, unequal

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treatment by teachers, the effects of tracking and testing, and patterns of financing.

While some of these issues are relatively new to the agendas of school reformers, the issue of inequitable finance patterns is one which has received considerable attention earlier in the century. Efforts by Ellwood Cubberly to stimulate state aid in the early years of the century, the promotion of foundation aid programs in the 1920's and of percentage equalizing programs in the 1960's were all directed at more equal distributions of school revenues.[1] Court cases and legislation prompted in part by Serrano v. Priest in California have continued these equalizing efforts. But here too the issues have become increasingly complex: we now realize that the simple reallocation of money alone will not solve the resource inequities we perceive, but that a number of other factors other than dollar inequalities--including cost variation, variations in "educational need," the effects of non-school spending on school resources, and diseconomies of large and small districts--affect the real resources available for schooling.

It is useful at the outset to distinguish among four different measures of school inequality. The simplest is revenue or expenditure per pupil. The second, somewhat more complex, involves real inputs per pupil--teachers with specific characteristics, buildings, books, and so on. The third kind

of measure focuses on real resources per pupil, where resources are defined as inputs which have some definite impact on pupils in terms of the goals of schooling. The distinction between inputs and resources recognizes that not all inputs are equally valuable to all children: bilingual teachers are a different resource to Spanish-speaking children than to English-speaking children; the value of vocational education facilities varies according to the local labor market. Finally, we can measure inequality in terms of school outputs, like achievement test scores, measures of personality development, the ability to obtain jobs or admission to higher education, etc.

While equity in schooling is most meaningfully discussed in terms of outputs, output measures are the least tractable both because individuals disagree on what output measures should be used and because our abilities to achieve targeted levels of specific output goals are very imperfect. Measures of resources are equally difficult to use, since we are currently unable to tell with any precision which specific inputs make significant differences in terms of school outputs. (There are some exceptions; e.g., the value of bilingual instruction to non-English-speaking children has been fairly well established.) Hence, it is usually necessary for purposes of legislation and administration to use the less satisfactory measures of revenues or real inputs in trying to achieve equity.

To date, all legislative reforms (as well as most court cases[2]) have measured inequality simply in terms of revenues per pupil. The step from revenues to real inputs requires indices of cost variation among school districts, to measure the variation among districts in the amount of specificed inputs which one dollar can purchase. As long as such variations exist, there can be serious inequalities in real inputs even with absolute equality in revenues per pupil. Since real inputs are a measure of equity one step closer to the concepts of equity embodied in output measures, a concern with equity in schooling may ultimately require cost indices in order to achieve equity in terms of real inputs rather than in terms of revenues.

This paper addresses the issue of how costs vary among districts within a state, and how states might adjust for such variation. There are at least five reasons for increased attention to cost variation as a concern of state-level policy. First, debates over equality of educational opportunity and the effectiveness of school resources have served to focus attention more on the outputs of schooling, reducing the exclusive emphasis of earlier years on dollar inputs. Secondly, long-term trends in the patterns of school financing have made cost-related differences more noticeable: as simple fiscal disparities among districts have been reduced during this century, and as proposals for further reductions are seriously considered, inequalities in purchasing power among districts

cease to be swamped by gross spending differences and become more obvious. Similarly, using state aid as a mechanism of inter-district equalization means that state policy is increasingly responsible for the distribution of school resources. Hence inequalities in real school resources due to cost differences, while they are remediable by the state, are increasingly caused by the state's failure to take cost variations into account. (In the extreme case where all revenue comes from the state--as is true in full state funding plans--then inequitable purchasing power is due solely to the state's policy.) Fourth, the increasing fiscal and educational crises of city schools have highlighted the potential importance of cost variation as an explanation of why these districts appear to perform so poorly, even where their spending levels are higher than in other districts.[3] Finally, the increasing strength of teacher unions--particularly in a few well-publicized cases involving central cities--has focused attention on another source of cost increases which is not under the control of local school districts, and whose size may vary drastically from district to district.

Of the expenditures which schools undertake, it is clear that teacher costs are the most important source of variation which might be corrected by the state. Teacher costs are quantitatively the most important expenditure, accounting for 51 percent of total current expenditures in the California sample which will be used in this paper, for example. Certain other

costs vary little, such as expenditures for books and materials; in other cases, such as transportation, the entire expenditure can be considered a regional cost variation. More complex problems arise in the case of administration and construction costs.[4] Hence it is logical to begin work on the construction cost indices with teacher costs.

Given both the increased visibility of cost variations and an increased urgency about correcting them, the first step is the definition of an index which adequately measures cost variations among districts. Not all the sources of variation in teacher costs should be included in such an index. Some districts will want to raise salaries to attract teachers of higher quality and, to the extent that the state does not compensate for property and income differences, districts with greater economic resources will be able to spend more for teachers. These are two elements of teacher cost variations ascribed to demand factors. On the other hand, a district may find that, because of its isolation, the working conditions within the schools, or the cost of living in the area, it must pay more to attract teachers of given quality than do other districts. Such cost variations should properly be corrected by the state, if the purchasing power per dollar is to be equalized throughout the state. These kinds of variations are due to differences in the conditions under which prospective teachers supply their services to various

districts; they are supply-side variations, as distinct from demand-side variations.

So far only one state has attempted the use of a cost index: in 1974 Florida adopted an index to adjust the amount of state aid per pupil.[5] The index, intended to represent cost of living differences among districts, was calculated according to the methodology of the Bureau of Labor Statistics, by pricing a representative "market basket" of goods and services. However, this method of constructing an index is unsatisfactory, for at least two reasons. First, teachers hired by a district may not live in that district, and hence local cost of living conditions may be irrelevant.[6] Second, and more importantly, the cost of living approach fails to consider that teachers may respond to local conditions other than living costs in deciding where to apply for teaching jobs.[7] Thus we might expect the density of an area, the size of a district, its socio-economic and racial composition, and other such factors to influence teacher location decisions, in addition to the local cost of living.

Hence the general problem in constructing a theoretically precise cost index is to separate supply from demand effects. Furthermore, it is desirable to do this in a way which relies neither on special assumptions about the nature of demand and supply for teachers, nor on assumptions about what kinds of variables condition demand and which reflect supply variations. The task of this paper is therefore to investigate the limita-

tions on separating supply from demand effects in a methodologically defensible way, and to indicate several different methods of calculating cost indices. Much of the paper is unavoidably technical in nature. Section VI contains our conclusions and policy recommendations, and the general reader is urged to skip the (often tedious) details of sections II through V, which will be summarized in the remainder of this section.

In section II a model of school district decisions, focusing on the teacher hiring process, is developed. The model assumes that three aspects of overall teacher costs--the salaries paid teachers of given quality levels, teacher quality, and the teacher-pupil ratio--are of concern to school districts. Assuming further that districts display some consistency in their fiscal decisions, the model will prove useful in two ways: it will generally clarify the issues central to estimating cost indices, and it will indicate the limited methods available in attempting to separate supply from demand effects. In particular, we will conclude that there is no way to avoid the need for strong a priori assumptions, and that the kind of data available on school district decisions prevents a more objective calculation of supply effects.

The rather discouraging results of section II indicate that the most we can expect from statistical analysis is a series of equations describing teacher salaries, quality, and the teacher-pupil ratio in terms of the collection of

demand and supply variables. These include variables describing district economic resources, preferences for schooling, characteristics like size and density, descriptions of pupils, and state and federal aid. In section III such equations are estimated using data on a sample of 218 unified school districts in California, for the year 1971-72. The results are generally consistent with our expectations. Measures of economic resources (property value, income, and intergovernmental aid) and preferences for schooling tend to increase teacher salaries, salaries are higher in districts of larger size, of greater population density, and where pupil turnover is high. A measure of the salaries available to college graduates also increases teacher salaries, confirming the hypothesis that opportunities available to teachers outside the schools affect the salaries districts have to pay. But in contrast to these results, we are largely unable to explain variations in teacher quality, as measured by experience and degree levels. This indicates the importance of considering that teacher experience and education may not be particularly valuable to districts, and hence that costs incurred due to variations in these two measures or "quality" might properly be included in cost indices.

Given the conclusion in section II that strong a priori assumptions are necessary to calculate cost indices, a large number of potentially acceptable indices can be generated based on alternative, and untestable, assumptions. In section

IV a number of possible assumptions are described, with a number of corresponding indices calculated based on the results in section III. The various indices are then compared: the similarity among indices--the extent to which they all rank the same district high or low--and the variation in each index are both statistically summarized. The conclusions are far from comforting: while the variation in each index is relatively constant, the indices appear to be rather erratic in that the correlations among them are not as high as would be desirable. This means that the assumptions used in calculating an index are critical to its distributional effects.

Given the possible indices developed in section IV it remains to apply these indices in a state aid program. Most commentators have assumed that an index would be used simply to correct the amount of state aid distributed to each district, making the purchasing power per dollar of aid equal across all districts. But this approach means that the purchasing power per dollar of locally-raised revenue would continue to be unequal. Particularly in states where local revenue is a relatively greater fraction of total revenue, failure to correct the effects of cost on local revenues would leave serious inequities. Section V develops one possible way for the state to accomplish a correction through its state aid formula. Unfortunately the formula which results is extremely complex. No particular solution to this problem

is offered; this remains an issue which school finance reformers need to address.

In one sense the results of this paper can be viewed as discouraging, since we conclude that it is impossible to calculate a theoretically precise cost index without making strong, and inevitably political, assumptions about teacher labor markets. But this does not mean that statistical research is pointless. On the contrary, the kind of analysis performed in sections III and IV is a critical first step, necessary in defining the kinds of political decisions which need to be made both to evaluate the need for cost corrections and to calculate any kind of cost index at all.

II. A Model of School District Decisions

In considering school personnel policy, a number of decisions are made simultaneously. The number of teachers hired will determine both the teacher-pupil ratio, which is generally considered a determinant of school quality, and influence total teacher costs. The salaries paid teachers will obviously affect costs but, assuming that better-quality teachers respond to wage differences among districts, salaries will also determine the quality of teachers in a district. Hence the decisions about the teacher-pupil ratio, teacher quality, and wages are to some extent made jointly.

To formalize this model, assume that school districts try to maximize an objective function U, where they consider the

impact on education services E and the local tax rate T of any expenditure decision.[8] Education services are in turn considered to be a function of the teacher-pupil ratio N and the quality of teachers Q. (We could in addition include non-teacher expenditures in this model, but this adds nothing to the analysis of teacher hiring patterns.) The wage rate for teachers is W, and the total cost per pupil of teachers is $W \cdot N$. The tax rate is calculated as local revenue - expenditures minus intergovernmental aid A - as a fraction of property valuation V. Therefore the school district maximizes an objective function given by:[9]

$$(1) \quad U\left(E(N,Q), \frac{W \cdot N - A}{V}\right)$$

This objective function is the source of the district demand for teachers of varying numbers and quality. It is subject to one critical restriction: that imposed by the supply of teachers to a particular district. This can be most generally expressed as an implicit function:

$$(2) \quad g(N,W,Q,S) = 0$$

where S represents a number of factors which influence the supply of teachers among districts, including size, location, the nature of the student body, and so forth. Equation (2) expresses the assumption that the supply of teachers is a function of the teacher-pupil ratio (which reflects "working conditions" as well as the number of teachers necessary), the wage paid, and the quality of teacher desired, as well as the

characteristics of the districts summarized in S.[10] If from equation (2) we express supply as W = W(Q,N,S) and substitute this into the objective function, the district then maximizes

$$(3)\quad U=U\left(E(N,Q),\ \frac{N \cdot W(Q,N,S) - A}{V}\right)$$

and the variables which the district is free to choose include N and Q. If, alternatively, we express supply as Q = Q(N,W,S), then the objective function is:

$$(4)\quad U = U\left(E(N,Q(N,W,S)),\ \frac{N \cdot W - A}{V}\right)$$

and the decision variables are N and W. While we have information on N, W, and Q, only two of these three variables are free to vary; one of them will be constrained by the supply function.

From equations (3) and (4), it is possible to write expressions for the outcomes of decisions about N, Q, and W as functions of demand and supply variables. Clearly, from equation (3), N and Q are chosen <u>at the same time</u>; neither is prior in any logical or temporal sense. Hence they are both functions of the exogenous supply and demand variables only. That is, the reduced form equations are

$$(5)\quad N = N(S,D)$$

$$(6)\quad Q = Q(S,D)$$

where D represents a vector of demand variables, previously assumed to be arguments of the objective function U. These would include variables measuring local economic constraints and preferences for schooling, for example. Similarly, from equation (4), decisions about N and W are made simultaneously,

and to the above equations we can add one for W:

(7) $W = W(S,D)$

Equations (5) - (7) are the reduced-form equations of this model.[11] From this formulation it should be clear that it is inappropriate to include on the right-hand side any decision variables like N or Q. It is equally clear that estimating reduced-form equations can yield no information on which variables represent demand versus supply, since both kinds of variables enter the reduced-form equations. Such a separation can be accomplished only by making a priori--and, of necessity, ad hoc--judgments.

It is now useful to look at the intersection of demand and supply in greater detail. Consider first what demand and supply would look like if quality were held constant at some level. As depicted in Figure 1, demand is downward-sloping: as the wage increases, the teacher-pupil ratio will fall, since a higher N costs more. Supply is likely to be non-linear as shown: as the pupil-teacher ratio increase, initially the wage rate can fall because with better working conditions (higher N) prospective teachers will require less money. However, if the total supply of teachers is at least somewhat inelastic, then as N increases the district will have to increase wages to draw teachers away from other districts or out of other occupations, and the supply curve will rise. The outcomes for W and N will be determined by both demand and supply factors.

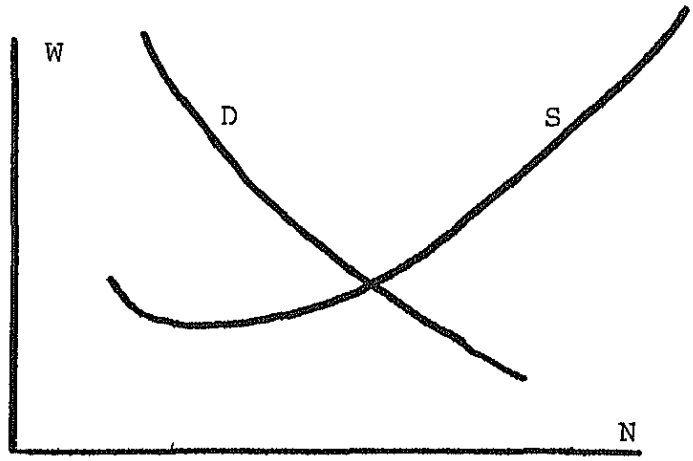

Figure 1

Q fixed

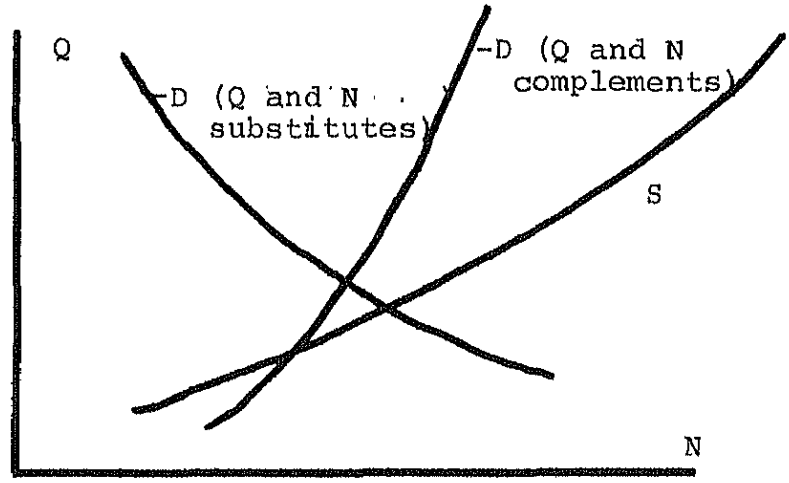

Figure 2

W fixed

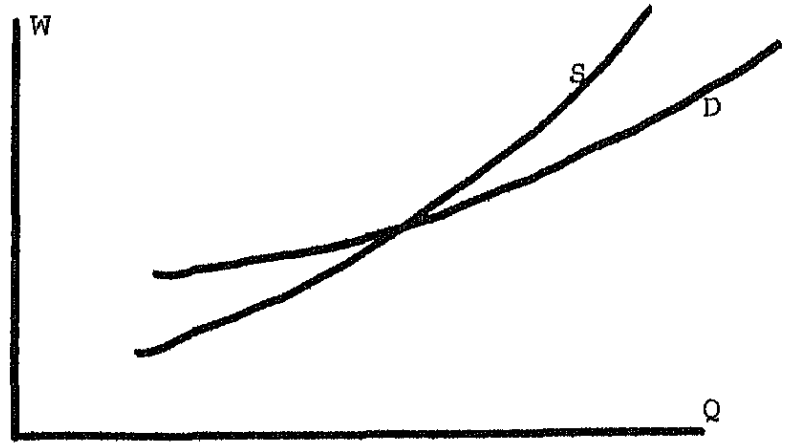

Figure 3

N fixed

Consider now the supply and demand functions with W fixed. Supply will be upward-sloping as drawn in Figure 2: as working conditions improve (as N increases), the quality of teachers will increase. The demand function is more complex. From the maximization of equation (1) with W fixed, a level of N will be chosen. This will vary as Q varies only if Q influences the effectiveness of N in producing educational services E. If N and Q are complements, then the demand curve will increase as N increases; if N and Q are substitutes in the production of E, the demand curve will have a negative slope, as shown in Figure 2.[12] If the effectiveness of N is not dependent on Q, then the demand curve will be vertical. Again, the general point to be drawn from Figure 2 is that decisions about N and Q will be a function of both demand and supply.

Now consider the case where N is fixed. As W increases, the quality of teachers supplied to a particular district should increase--assuming, of course, that high quality teachers have better options, either in terms of jobs in other districts or in fields related to but outside teaching. The demand curve in this case has a positive slope: as the wage increases the district will demand higher quality to offset the disutility of increased taxes.[13] The stability of the equilibrium in this case may be problemmatic if the demand curve has a steeper slope than the supply curve; but

in general both supply and demand factors will influence the equilibrium itself.

In each of these three cases, therefore, the decisions made by school districts will be affected by demand and supply considerations; neither the demand curve nor the supply curve can in general be identified. However, for each of the cases depicted in Figures 1-3 an a priori assumption can be introduced which leads to identification. From Figure 2, if N and Q are neither complements nor substitutes, then the demand curve is vertical as shown in Figure 4. Then variation in Q represents shifts in the supply curve only, while variations in N represent demand shifts only. Somewhat similarly, if we assume that districts are not in general willing to pay more for teacher quality--at least for the measures of quality generally available, like experience and degree levels--then the demand curve in Figure 3 becomes horizontal, as shown in Figure 5. All variations in Q are due to supply shifts, while variations in W are wholly influenced by demand factors.

Both Figures 4 and 5 imply that teacher quality variations reflect supply variables only. But this is the direct result of assuming in both cases that quality--as measured--is essentially worthless to school districts, so that they will not demand additional quality. (The appropriateness of this assumption will be examined in the next section.) But this simply points out the necessity for extending demand and supply

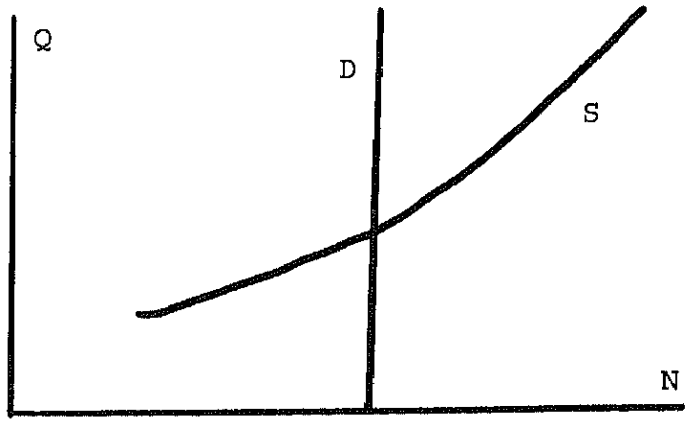

Figure 4

W fixed

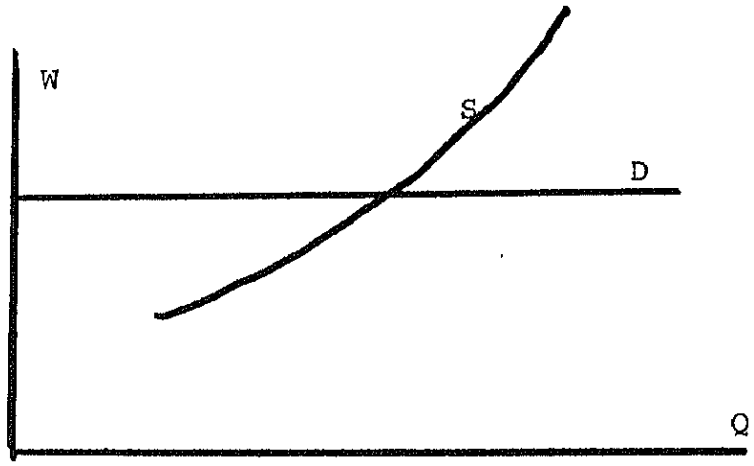

Figure 5

N fixed

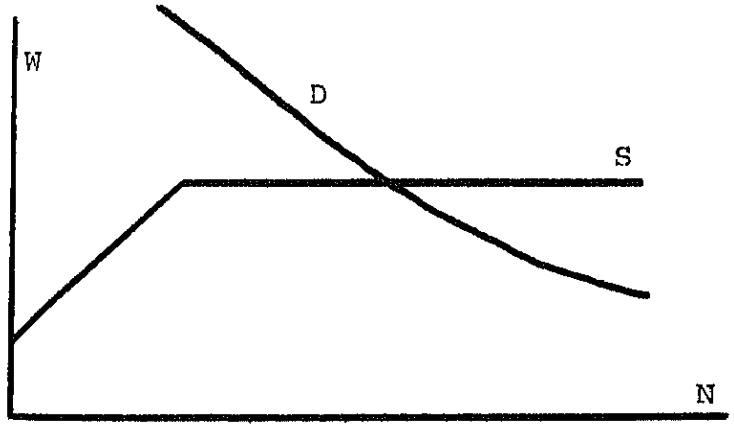

Figure 6

Q fixed

analysis to teacher quality and for including teacher quality in cost indices. It in no way solves the problem of how to treat teacher wages. In order to deal with this problem a common assumption has been to assume that the supply function of Figure 1 is perfectly elastic: that a district can hire as many teachers of a given quality as it wants.[14] This situation, depicted in Figure 6, means that all variation in wages is due to shifts in the supply curve, and all variations in the teacher-pupil ratio would be due to demand-side factors. Since in this case all variation in teacher salaries constitutes true cost variation, a price index would be a straightforward standardization of salaries themselves.

While the assumption of perfect elasticity described in Figure 6 simplifies the task of calculating a price index, the validity of the assumption itself becomes an issue of greater importance. If the assumption could be accepted on empirical grounds, then the problem would be solved. But testing this hypothesis empirically requires estimating the supply function of Figure 3, and thus does not relieve us of the necessity for identifying the teacher supply function.[15] There are, of course, a variety of theoretical arguments which can be made in defense of the perfectly elastic supply curve,[16] but they are not a substitute for empirical conclusiveness.

The conclusions of this section are discouraging. From a general model of school district decisions, it proves

impossible to identify teacher supply functions except by making strong a priori assumptions about the nature of demand or supply. This means, in particular, that we cannot be sure whether variables which affect wages, quality, and the teacher-pupil ratio in reduced-form equations are demand or supply variable, or some combination of the two. Since supply-side variables cannot be identified econometrically, the only alternative is again to make strong a priori judgments about which variables tend to represent supply and which represent demand.[17] In short, given the nature of teacher labor markets and the kind of information available from them, the estimation of teacher cost indices requires either of two strong assumptions, either an assumption about the shape of supply and demand curves, or assumptions about which variables represent supply and which represent demand.

III. Estimating Reduced Form Equations

Given the difficulties in separating demand from supply, outlined in the previous section, the only econometric information useful to calculating cost indices is that derived from reduced-form equations, like those given of equations (5) - (7). From such specifications, one can then proceed to calculate a variety of cost indices based on different kinds of a priori assumptions; this will be the subject of section IV.

The sample used to estimate the reduced-form equations consists of 218 California unified school districts, with data

for the year 1971-72. In that year California contained 242 unified districts, 708 elementary districts, and 117 secondary districts; but while unified districts constituted a minority of districts, they did contain 66 percent of pupils in the state. Twenty-four unified districts were not included in the sample because either Census data or data on salaries and teacher quality measures were missing. The excluded districts were universally small and rural, but inspection of the sample indicates that it still includes a sufficient number of small, rural districts that the results are unlikely to be biased by these omissions.

For these 218 districts, data is available on salary structures, and on the numbers of teachers at every credential and experience level within the structure. From this data, four different measures of the wage W were derived: the salary paid to teachers with a B.A. but no experience (SBA); the salary for B.A.'s with five years of experience (SBA5); the salary for those with M.A.'s (SMA); and the salary for M.A.'s with five years experience (SMA5). Four measures of teacher quality Q were constructed: the proportion of teachers with a B.A. plus thirty units (PBA30); the proportion with a B.A. plus forty-five units (PBA45);[18] the proportion with five or more years of experience (P5YR); and the proportion with ten or more years of experience (P10YR). In addition, the average teacher salary (AVSAL)--which combines variation in both wage rates and in degree and experience levels--will be used. Data on

the teacher-pupil ratio for elementary and secondary levels separately is available (ELTPR and SECTPR), along with the overall teacher-pupil ratio (TPR). Other district variables--including total expenditures per pupil, property valuation per pupil, the racial composition of students, student and staff mobility rates, size as measured by average daily attendance, and amounts of intergovernmental aid--are collected by the State Department of Education. Finally, a wide range of variables reflecting district characteristics are available from the 1970 Census.[19] An appendix tables summarizes the variables actually used,[20] their mnemonics, means, and standard deviations.

Although this data set is extensive, there are two kinds of variables which are not included. First, there is no data for California districts on measures of teacher quality other than degree levels and experience. This will prove to be a critical weakness in the data assembled. Second, there is no data appropriate for testing the hypothesis that teacher unions affect salary levels. Data on membership levels is inappropriate because membership patterns and union strength are precisely the opposite of what one might expect: in rural areas, where unions are relatively less powerful, their membership is a much larger proportion of teachers than in urban areas, where unions are stronger. In addition, since California has not had a binding arbitration law, teacher unions have operated not so much through the threat of strike

as by attempting to affect school board elections and otherwise working through normal political channels, increasing the difficulty of defining an appropriate measure of union strength. Finally, data on union characteristics are not systematically collected for districts, so the calculation of any measure would be tremendously time-consuming. However, the lack of a variable measuring union power may not be particularly troublesome; other who have investigated the impact of unions on teacher salaries have concluded that their influence is on the whole trivial.[21] This does not preclude the possibility that unions are powerful in a few districts, for example in central city districts.

The reduced-form equations for measures of wages, quality, and the teacher-pupil ratio are given in Tables I-III.* For the sake of comparison, measures of expenditures per pupil--teacher expenditures, non-teacher expenditures, and totals--are described in Table IV.[22] By and large, these results are not particularly surprising. Consistently, measures of local economic resources (like V, MFAMI, and LFAMI) increase spending levels, salaries, teacher quality, and teacher-pupil ratios, as do variables measuring socio-economic status (e.g., ED and PCOL). Home ownership and a high proportion of residential property (VRES) tend to reduce support for schools, probably because both variables measure the extent to which local residents are forced to pay local taxes for schools, rather than being able to pass them on to others. The effects

*See Appendix for Tables I - IV.

of intergovernmental aid variables are varied. Non-Title I federal aid--largely impact aid--increases teacher expenditures as well as salary levels, teacher quality, and the teacher-pupil ratio, but Title I--although it is often insignificant--does just the opposite. State general aid (SNCA) and special education aid (SSEA) increase support for teachers, but state categorical aid has the reverse effect, probably because it is associated with patterns of special needs (e.g., transportation) which reduce teacher expenditures. The results for other state aid and county aid--two minor sources of funds--are erratic and sometimes puzzling.

The variables which are significant in these reduced-form regressions may be supply-related, demand-related, or a combination of the two. For the indices which will be calculated in the next section, it is useful to analyze the results in Table 1 more carefully, in order to specify some a priori expectations about which variables represent supply and which are demand-related.

First of all, we can safely assume that all intergovernmental aid variables are demand-related. Such aid may influence districts to change their teacher and non-teacher fiscal decisions in various ways--either by mandating certain decisions or by providing resources to facilitate them--but there are no reasons why teachers should care directly about the source of revenues in a district. If, for example, teachers react to the socio-economic backgrounds of pupils, and these

are correlated with certain types of aid (as is true for Title I aid), then this aspect of teacher supply should be described in terms of local socio-economic status. Similarly property value per pupil (V) is probably a pure demand-side variable, reflecting the local tax base but not describing anything about local residents or the student body. The composition of property (VRES) might affect the desirability of a district as a place to live, but since districts in California are relatively small there can be no presumption that teachers live in the district where they teach, and the presence of non-residential property need not affect teacher supply; hence this too is likely to be a demand variable. The signs of these variables in Tables 1-4 are in fact consistent with these demand-related explanations.

On the other side, there are some variables which are generally thought to reflect supply-side conditions almost entirely. The size of the district (ADA and ADA^2), pupil mobility (ELMOB), and the county population density (DEN) are among such variables. Another supply-related variable is CINDEX, which is an index of opportunity costs for teachers. Opportunity costs are here measured by the average earnings for college graduates in the <u>county</u> of a school district, which assumes that alternative occupations for teachers will be found among the jobs which college graduates hold.[23] For these variables, the coefficients in Tables 1-4 are all consistent with supply-side effects.

Finally, there are a number of variables whose effects on wages are completely ambiguous; these include VOWN, ED, LFAMI, UE, AGE518, and PORIEN. For each of these, plausible explanations of an effect either through demand or supply (or both) can be imagined. For example, all of these are related to economic resources, and could therefore affect salary scales through their influence on the local demand for schooling. But equally plausibly, teachers may prefer to teach in districts with high schooling levels, with a low concentration of poor families, with a low concentration of minority pupils, and where the population is relatively stable (as measured by home ownership patterns). The unemployment rate may serve as a proxy for opportunity costs, since opportunities for jobs outside of teaching will presumably be lower where the unemployment rate is high. Similarly, either a demand or a supply explanation for AGE518 can be supported: while this variable may indicate the effect on school resources per pupil of a large school-age population, it may also be true that teachers prefer to teach in districts where there are more children and the population is consequently more "child-oriented."[24]

Some of the ambiguities are resolved by the signs of these variables. The signs of ED, LFAMI, and PORIEN are consistent with demand-side explanations only--or at least with the dominance of demand effects over supply effects. But for the remaining three variables--VOWN, UE, and AGE518--both

supply and demand explanations imply that coefficients will be negative, and hence the reduced-form estimates provide us with no help in disentangling the two kinds of effects.

The effect of poor and minority pupils on teacher salaries and on expenditures is a critical subject by itself. From Table IV, it is clear that non-teacher expenditures and total expenditures per pupil are higher in districts where there are relatively more black students. Other researchers have found that districts pay more in salaries where there are more poor and/or non-white pupils,[25] and the assumption that "battle pay" is necessary in such districts is widespread. But this study found no evidence that the proportion of black, Chicano, Oriental, or low-income pupils in a district increases salaries, all other factors constant. The only significant affects of poverty and minority representation was the negative effect of PORIEN on SBA, the negative effect of LFAMI in Table I, and the positive effect of PORIEN on PBA30 in Table II. Hence there is no basis in California for the assertion that teachers demand additional pay for teaching minority and poor pupils, at least on a state-wide basis.[26]

The other reduced-form equations which will be used in calculating cost indices are those describing teacher quality in Table 2. In contrast to the regressions describing salaries, these are uninformative and of poor explanatory power. The only independent variable which is consistently significant is property valuation, which as expected increases teacher quality.

The effects of the other independent variables are highly variable, and in some cases--as for unemployment--it is difficult to interpret the sign. The abysmally low explanatory power of these regressions indicates that variation in these measures of "quality" is largely unexplained by any of the independent variables available. This is particularly surprising because of the large number of available variables conventionally interpreted as measures of demand for high-quality schooling, and which might be expected to explain variations in these four measures of "quality." It appears, therefore, that these four measures do not reflect teacher quality, at least in the sense of measuring teacher attributes which school districts attempt to increase. By and large, then, these regressions support the hypothesis underlying Figures 4 and 5--that the measures of teacher quality available are not *per se* valuable to school districts.[27]

IV. Alternative Teacher Cost Indices

From the information in the reduced-form equations of the previous section, we can now proceed to calculate a variety of cost indices, depending on the *a priori* assumptions introduced. Since these assumptions cannot be directly tested, the choices among them must be political rather than empirical. For policy purposes, it is therefore critical to know how sensitive indices will be to the alternative possible kinds of assumptions.

The results of the previous section highlight the necessity for considering "quality" variation--defined by experience and degree levels--in addition to salary variation in constructing indices of teacher cost. Table V displays the possible combinations from considering variations in salaries and "quality" as demand-related, supply-related, or as a mixture of demand and supply. Each of the nine cells calls for a different method of constructing a cost index, and it is worth describing the indices which results in some detail. Only in the case where variations in both salaries and "quality" are found to be wholly demand-related is there no necessity to construct cost indices; in this case all variations in teacher cost are due to demand factors.

TABLE V
Possible teacher cost indices

	Teacher "quality"		
Teacher salary	Supply-related	Demand-related	Mixture of demand and supply
Supply-related	I	IV	VI
Demand-related	II	no index necessary	VII
Mixture of demand and supply	III	V	VIII

The cases where teacher "quality" is assumed to be entirely demand-related are described in cells IV and V. Cell IV corresponds to the assumption that teacher supply functions are perfectly elastic--as depicted in Figure 6--so that all variation in wages is supply-related rather than demand-related. In this case, salaries themselves--suitably standardized--constitute the relevant cost index. In comparing different indices below, we will label these indices IVa, IVb, IVc, and IVd, corresponding to the four wage measures SBA, SBA5, SMA, and SMA5. In addition, a fifth index, IVe, will be calculated on the basis of an average of these four wage rates.[28]

Cell V represents the case which motivated the model of Section II: "quality" variation is assumed to be demand-related and hence not considered in a cost index, but wage variation must be separated into demand and supply components. In order to observe the effect on cost indices of considering only part (rather than all) of wage variations as supply-related, we will impose the a priori expectations described in the previous section, separating the independent variables of these wage equations into demand and supply variables. From the regressions in Table 1, we will therefore construct cost indices Va, Vb, Vc, and Vd, assuming that the following variables reflect supply: UE, OCINDEX, DEN, ADA, ADA2, ELMOB and TRAN. This reflects an arbitrary decision that, of the variables appearing in Table I which seem ambiguous in

their effects, UE is primarily a supply-side variable while VOWN and AGE518 measure demand effects.

The case described by Cell I is the simplest. Here all variation in wages and "quality" must be reflected in a cost index; hence the average teacher salary, AVSAL, constitutes the appropriate cost index (labeled index I below). For Cell II, however, only "quality" and not wage variation should be included in the index. As indices IIa, IIb, IIc, and IId we will construct indices based on the four "quality" measures PBA30, PBA45, P5YR, P10YR. Another simple "quality" index, given the fact that the data collected on teacher wage structures is not complete,[29] is to construct an average wage, W*, from the four wage measures available; then Q* = AVSAL/W* yields an index of variation in teacher quality among districts, an index which will be labeled IIe. A final index, IIf, will be calculated as the first principle component of a factor analysis of the four quality measures.[30]

This cell labeled III requires an index which includes all variation in "quality" measures, but only part of the variance in wages. An appropriate index could be constructed by combining the methods for cells II and V. However, this seems needlessly complex for the purposes of comparing indices, since the results will be intermediate between those obtained from indices I and II.

In the cases described by cells VI, VII, and VIII, some part of "quality" variation is ascribed to demand. This

situation has not been systematically analyzed in this paper, except in two indirect ways: the reduced-form regressions of Table II indicate the amount of variation which can be accounted for by independent variables through to be demand-related; and the analysis of average teacher salary (AVSAL) in Table I implicitly includes an analysis of "quality" since this one aspect of variation in AVSAL. By separating demand and supply variables on an a priori basis in the regression for AVSAL from Table 1, an index corresponding to cell VIII can be derived.[31] Given the weakness of the analysis of quality measures in Table II, it seems pointless to construct indices corresponding to cells VI and VII. A more precise analysis of teacher quality variations remains an important research task.

We need now to compare the variety of indices derived from Table V and the reduced-form regressions. There are two comparisons which should be of concern. The first is whether two indices are similar, in the sense that they rank a particular district consistently high or low. This can be simply measured by the correlation coefficient between two indices. The second issue of concern is whether the variation in an index is large or small. For example, it makes a great deal of difference whether the highest cost district has costs 10 percent or 20 percent above the average. The variation in an index can be simply measured by its standard deviation.[32] We will therefore use these two statistics to evaluate the

various indices described above. Note that the usual procedure of simply reporting cost indices for specific districts, while it may be intuitively appealing, fails to separate these two distinct sources of variation.

There remains the problem of the appropriate standardization in comparing indices. For comparing the similarity of indices with correlation coefficients, there is no particular problem, and indices should be standardized so that the mean for all districts is one. But the effective variation in an index--e.g., the extent to which it disburses relatively more money to high-cost districts--can be affected by the amount of money distributed. Therefore, it is desirable to standardize indices so that all of them imply the same amount of aid distributed to local districts. Indices should therefore be standardized so that they have a value of one at the statewide mean for <u>pupils</u>, not the mean for districts. This requires an index weighted by district attendance. In this case one dollar per pupil adjusted by the relevant district index sums to the same amount for every index.

Table VI presents the correlations among the various indices, the standard deviation when the index is weighted by ADA, and--for comparison only--the unweighted standard deviation. In addition to the indices described earlier, an index of total teacher expenditures per pupil--which is the average salary (AVSAL) times the teacher-pupil ratio (TPR)--has been included, labeled TEXP. In looking at these figures,

TABLE VI

Correlation coefficients and standard deviations for teacher cost indices

	IVB	IVC	IVD	IVE	VA	VB	VC	VD	I	IIA	IIB	IIC
IvA	.881	.797	.809	.905	.612	.593	.491	.510	.724	.024	.131	.108
IVB		.826	.920	.960	.633	.629	.509	.539	.823	.148	.188	.143
IVC			.922	.940	.540	.546	.494	.492	.721	.095	.140	.146
IVD				.975	.637	.641	.537	.558	.857	.200	.249	.224
IVE					.640	.639	.538	.557	.833	.137	.196	.172
VA						.977	.858	.877	.638	.051	.105	.143
VB							.892	.923	.623	.037	.081	.128
VC								.960	.464	-.054	.031	.045
VD									.501	.001	.045	.051
I										.405	.471	.492
IIA											.706	.370
IIB												.461

	IId	IIe	IIf	VIII	TEXP	Standard deviation (weighted)	Standard deviation (unweighted)
IVA	.204	.310	.158	.471	.419	3.683	.0606
IVB	.206	.421	.225	.522	.436	3.515	.0726
IVC	.138	.272	.169	.441	.375	3.504	.0669
IVD	.204	.465	.286	.527	.391	3.478	.0781
IVE	.199	.400	.231	.521	.425	3.537	.0668
VA	.197	.434	.163	.846	.108	3.957	.1528
VB	.187	.410	.142	.900	.090	3.264	.1472
VC	.115	.246	.050	.840	.024	4.067	.2507
VD	.128	.287	.076	.889	.032	3.889	.1445
I	.553	.838	.622	.521	.450	3.564	.1115
IIA	.304	.541	.758	.002	.231	3.825	.1185
IIB	.372	.593	.843	.010	.346	4.546	.2381
IIC	.566	.654	.758	.095	.175	3.625	.1386
IID		.729	.729	.185	.168	3.713	.3268
IIE			.813	.355	.307	3.602	.0664
IIF				.094	.306	3.920	.1422
VIII					-.001	2.804	.1342
TEXP						3.291	.2123

it is difficult to know what the relevant standards of comparison should be--i.e., what constitutes an acceptably high correlation coefficient, or when differences in two standard deviations are large or small. However, it seems unnecessary to specify precisely what would be a correlation large enough to accept two indices as essentially equivalent, because the correlation coefficients in Table VI vary so widely. While some of them are quite high--e.g. those among IVa, IVb, IVc, IVd, and IVe, and among Va, Vb, Vc, Vd, and VIII--some of the others are insignificantly different from zero, indicating no relationship at all between pairs of indices. The point is a simple but powerful one: alternative assumptions can yield substantially dissimilar indices. This is not surprising when indices reflecting wage variation (e.g., IVa, b, c, d, and e) are compared with indices reflecting quality variation (like II a, b, c, d, e and f). But it is discouraging to find the correlations between salary indices assuming that teacher supply is fully elastic (cell IV) and those assuming supply to be partially elastic (cell V) to be as low as they are, ranging between .5 and .6.[37] The logical conclusion is that indices calculated are extremely sensitive to the choice of a priori assumptions.

The results for the standard deviations (weighted by ADA) are rather different. While they range has high as 4.54 and as low as 2.80, the majority fall between 3.5 and 3.9. Hence

the method of calculation makes relatively little difference to index variation. In part, this finding is due to the standardizing influence of weighting by ADA, so as to make sure that all indices described equivalent amounts of state aid; the unweighted standard deviations vary more than the weighted ones do.

These findings--perhaps unfortunately--place an additional burden on the assumptions used in deriving cost indices. If the correlations among indices had been high but the standard deviation rather different, then the only issue to resolve would be that of the standard deviation of the index actually used. In the absence of accurate methods of calculating the "correct" standard deviation, it could be adjusted either by explicitly normative principles or by political bargaining, and we could still be sure that high-cost districts would be compensated relative to low-cost districts. However, since the correlations among indices are not uniformly high, then we can have little confidence that any particular index will "correctly" order school districts; the possibility of serious errors in adjusting school aid is therefore larger.

V. Utilizing Cost in Indices in State Aid Formulas

This paper has so far been concerned with the issue of how to construct cost indices. But a further question which has not yet received systematic attention is that of how the state should use cost indices, assuming that acceptable cost

indices can in fact be constructed. In this section purely algebraic analysis will be used to indicate that--according to one interpretation of what the state's goals ought to be--the state aid formulas which result are quite complex.

Most commentators have assumed that state aid formulas would simply adjust the amount of state aid by the index C. For example, a foundation aid program can be represented by the formula $S = a - bV$ where V is property valuation per pupil. The cost correction generally assumed in this case would be

$$(8) \quad S = (a - bV)\, C$$

so that high-cost districts receive relatively more aid than do low-cost districts. Alternatively, in the case of a district power equalizing formula, $S = mL = (k/V - 1)\, L$, where m is the state's matching rate, L is local revenue per pupil, and k is some constant. Then the analogous cost correction is

$$(9) \quad S = C \cdot (k/V - 1) \cdot L \rightarrow m = C(k/V - 1)$$

In both of these cases the corrections imply that the purchasing power per dollar <u>of state aid</u> has been adjusted for cost variations among districts.

However, in these cases there remains a substantial fraction of school revenues which come not from the state but from local resources, and these will continue to reflect cost variations. Eliminating this source of cost variation is considerably more difficult. We observe expenditure variations

across districts, and can describe them by regression equations similar to those in Table IV; we don't actually observe measures of educational services E. Thus we observe, as in Table IV an expression for instructional expenditures I:

(10) $I = f(m, A; C, V, X_1, X_2, \ldots) = m \cdot L + A$

where X_i represent other explanatory variables. Assuming that we have calculated a "correct" cost index C, we also have an index of educational services E:

(11) $I = E \cdot C \rightarrow E = I/C$

The goal of the state might be to eliminate the effect of cost variation on educational services E--rather than eliminating the effect of cost variation on state revenue alone, or eliminating the effects of cost on expenditures per pupil E, which are themselves partly a function of cost variation. Hence the state's criterion might be:

(12) $\partial E/\partial C = 0$

From equations (10)and (11), the total derivative of expenditure with respect to cost dI/dC equals

(13) $$\frac{dI}{dC} = \frac{\partial E}{\partial C} \cdot C + E$$

$$= \frac{df}{dC} = \frac{\partial f}{\partial m} \cdot \frac{\partial m}{\partial C} + \frac{\partial f}{\partial A} \cdot \frac{\partial A}{\partial C} + \frac{\partial f}{\partial C} + \frac{\partial f}{\partial V} \cdot \frac{\partial V}{\partial C}$$

$$+ \sum_i \frac{\partial f}{\partial X_i} \cdot \frac{\partial X_i}{\partial C}$$

(The partial derivatives like $\frac{\partial f}{\partial m}$ and $\frac{\partial f}{\partial A}$ are the coefficients from regressions such as those in Table IV.) The expression in (13) can be readily interpreted. The first term $(\frac{\partial E}{\partial C} \cdot C)$

represents the effect of cost on school services, and is a familiar price effect: where costs are high, we expect school districts to purchase fewer services than if costs are low. The second term represents the direct effects of cost on expenditure levels, the fact that expenditures per pupil with services fixed must be higher where costs are higher than where costs are lower.

For $\partial E/\partial C$ to equal zero, we have from equation (13) the condition that

$$(14) \quad \frac{\partial E}{\partial C} = \frac{df/dC - E}{C} = \frac{df/dC}{C} - \frac{I}{C^2} = 0$$

This formulation is general in the sense that it allows for cost correlations to be achieved either through matching aid or through non-matching aid A. It can be shown that achieving the criterion of equation (12) is impossible with non-matching aid,[34] and that matching aid is necessary. Asssuming therefore that $\partial A/\partial C$ is zero, the following expression results from equations (13) and (14):

$$(15) \quad \frac{\partial m}{\partial C} = \frac{\frac{mL}{C} - \frac{\partial f}{\partial C} - \frac{\partial f}{\partial V}\frac{\partial V}{\partial C} - \sum_i \frac{\partial f}{\partial X_i}\frac{\partial X_i}{C}}{\partial f/\partial m}$$

Integrating this yields the following equation for the matching rate:

$$(16) \quad m = C^{L/\partial f/\partial m} \cdot \frac{\left(\frac{\partial f}{\partial C} + \frac{\partial f}{\partial V}\frac{\partial V}{\partial C} + \sum_i \frac{\partial f}{\partial X_i}\frac{\partial X_i}{\partial C}\right)}{\partial f/\partial m} \cdot C + K$$

where K is a constant of integration. The state aid formula implied by this matching rate is obviously complex; even the matching rate is a function of local revenue per pupil L.

Clearly the expression in equation (16) is too cumbersome to use in state aid formulas; some approximation would be necessary. There is, of course, one easy way out: as state aid increases and local revenue per pupil decreases, then cost variations operating through local revenue become relatively less important. At the extreme, where state aid constitutes all of school revenues, then the problem treated here disappears completely, and the simple correction of state aid by cost indices is sufficient. However, in most states local revenue remains an important source of revenue, and is in fact the critical source of revenue variations among districts. Obviously, the decision to correct only state revenues for cost variations, to correct all revenues, or to take some intermediate approach is a policy decision. But it is not a policy option without political content: adjusting for costs of local revenue will be favored by those districts with high costs and large amounts of local revenue--i.e., wealthy suburbs close to central cities--and opposed by low-cost, low-spending districts, which are likely to be in poor, rural areas. The point of this section is simply that the issue of how to use cost indices is far from being solved.

VI. Conclusions and Policy Implications[35]

The conclusion from the technical work of sections II-IV is that no empirical technique is now available to separate supply from demand and thereby calculate theoretically precise cost indices. In order to calculate any kind of index at all, one of two alternative assumptions is necessary. We can assume that the supply of teachers to a district is perfectly elastic--essentially unaffected by the wage offered them--in which case all the variation in teacher salaries should be included in a cost index. Alternatively, if we know from a statistical analysis which variables cause variations in salaries, then we can make a priori judgments--will sometimes be arbitrary--about which variables describe supply-side effects, and calculate a cost index with these variables.

Both of these approaches require strong assumptions, but it does seem to us that the second is preferable, since some evidence suggests that teacher supply is not perfectly elastic. First, some of the variables which cause teacher salary differences in California are difficult to interpret as variables describing district demand; for example, district population, density, and the index of wages in alternative occupations are sensibly interpreted as affecting teachers supply, and viewing as demand-side measures seem strained. Second, the poor explanatory power of equations describing teacher experience and degree levels imply that "quality" may be an idiosyncratic

concept, varying widely among districts; if this is so, then individual districts may have to raise salaries in order to get enough of the particular kinds of teachers they are looking for.[36] Finally, the evidence on teacher turnover in California suggests that the supply of experienced teachers, at least, is responsive to salaries paid.[37] Hence we would prefer not to assume that teacher supply is perfectly elastic, but rather to attempt a priori judgments about which variables are supply-related in constructing teacher cost indices.

The main point is that, since strong assumptions are necessary in either case, a technical solution is unavailable; the calculation of cost indices at this stage must remain a political exercise. This does not mean that statistical analysis is worthless. On the contrary, describing variations in teacher salaries and quality--as in Table I and II above--is a critical first step, providing the information necessary to specifying what political judgments are necessary, enabling decision-makers to accept some variables as appropriate for inclusion in a cost index and to reject others as inappropriate.

It is useful to outline some of the difficult decisions which might be required. First of all, statistical analysis is unable to explain all the variation in teacher salaries; at best, we could explain 70 percent of the variation in average teacher salary, for example. The unexplained 30 percent represents district characteristics which are unmeasured or unmeasurable--such as local political structure, the influ-

ence of particular individuals, or a district's unique history--as well as some purely random effects. This unexplained variation could be either included or excluded in a cost index.[38] Second, some variables in Table I were identified as clearly supply or demand-related, and for others whose effects are ambiguous--the district education level, the proportion of low income families and of Oriental students--the estimated coefficients identified them as predominantly demand-related. But some variables--home ownership, the district unemployment rate, and the proportion of school-age children in a district--remained unambiguous in their effects, and required an arbitrary decision whether to include or exclude them in cost indices.

More politically sensitive problems arise in cases where teacher salaries and quality are due to variables like union power, the representation of minority pupils, and the sexual composition of a district's teaching force.[39] If variables representing union power are included in a cost index, then districts will have less incentive to resist union salary demands, and teacher costs are likely to increase in a self-reinforcing cycle. Though this proved not to be the case in California, in some states teachers may be paid more in districts with relatively more minority pupils. This raises the issue of whether racist teacher attitudes and teacher selection mechanisms should be institutionalized and rewarded by including minority representation in a cost index; on the

hand, it seems unfair to penalize minority pupils for prejudices which are a social problem much larger than the schools themselves. Finally, if female teachers are paid less than men, inclusion of a variable representing the proportion of male teachers in a cost index would similarly institutionalize and perpetuate this form of discrimination.

These three examples are part of the general problem of undesirable incentives which may be established through the state's use of a cost index. This problem extends most seriously to consideration of teacher experience and degree levels. We concluded in section III that only a small protion of the variation in these measures of teacher "quality" represented demand by individual districts, and therefore experience and degree levels might legitimately be included in a cost index. But this obviously would reduce the fiscal disincentives to hiring more experienced and better educated teachers, leading to an inflation in experience and degree levels.[40] If these attributes are in fact valuable in teaching children, then such a result would be worthwhile; but as long as there remains some doubt as to the efficacy of long-term experience and additional credentials--and as long as districts themselves show no particular inclination to invest in them--then such a system of state incentives needs to be carefully considered.

In general, then, statistical analysis permits a specification of what decisions need to be made in order to develop a

cost index. There does remain a number of research tasks which have yet to be undertaken; the nature of teacher quality as interpreted by local districts has not been systematically investigated,[41] and some possible methodological approaches have not yet been tried.[42] The usefulness of straightforward estimation of reduced-form equations describing teacher salaries and quality should now be clear. But in general we conclude that there is little hope of developing a technically sophisticated and theoretically precise way of separating supply from demand effects without making strong assumptions.

This raises the issue of how policy should be developed in the absence of an optimal procedure: what are the second-best alternatives? One was considered and rejected for theoretical reasons in the first section of the paper: the use of a cost-of-living index such as that adopted in Florida. Since theoretically perfect alternatives have not emerged, the theoretical flaws in this approach may be irrelevant; it might be that such an index would capture most of the variation of an index based on teacher supply variation, and be in addition intuitively (or politically) more appealing and easier or less controversial to calculate.[43] Indices based on reduced-form equations, like those developed in section IV, are of course second-best alternatives. One appealing modification would be to apply them on a county-wide rather than a district-wide basis, on the assumption that differences among districts within counties are largely random errors which ought

not be considered. As long as the equity issues generated by cost differences are real ones, the lack of a technically perfect cost index ought not prevent states from starting to attack this problem.

Obviously enough, the adoption of cost indices is political: some districts--particularly rural ones--will lose relative to others.[44] Beyond this consideration of power, statistical analysis like that of this paper should raise again the equity issues involved in cost indices. The indices calculated in section IV would uniformly redistribute state aid from some low-spending districts in rural areas, and towards different kinds of urban districts, some of which are hard-pressed central cities and some which are high-spending suburbs close to central cities. Given the perennial problems of rural districts in attracting and keeping teachers, in offering a varied curriculum, and in overcoming diseconomics of sparsity and small size, compared with the relative affluence and quality of many suburban school systems despite their higher costs, the equity of such a redistribution is questionable. The utilization of cost indices thus appears like an inefficient way of redistributing resources to cities. Despite the large variation in teacher costs identified by empirical work, the patterns in this variation suggest that correction of cost differences should be a policy issue which is secondary to the correction of spending differences between high-wealth

and low-wealth districts, between rural and urban areas, and between central cities and suburbs.

APPENDIX

VARIABLES AND MNEMONICS USED

Endogenous variables		Mean	Standard Deviation
SBA	Salary, B.A. with no experience	7139	433
SBA5	Salary, B.A. with 5 years' experience	8511	618
SMA	Salary, M.A. with no experience	8442	564
SMA5	Salary, M.A. with 5 years' experience	9902	774
AVSAL	Average teacher salary	10907	1215
PBA30	Percent of teachers with a B.A. plus 30 units	.7898	.0936
PBA45	Percent of teachers with a B.A. plus 45 units	.5322	.1267
P5YR	Percent of teachers with 5 years or more experience	.7151	.0991
P10YR	Percent of teachers with 10 years or more experience	.3951	.1291
ELTPR	Elementary teacher-pupil ratio	.0370	.0074
SECTPR	Secondary teacher-pupil ratio	.0598	.0209
TPR	Overall teacher-pupil ratio	.0439	.0086
TEXP	Teacher expenditures per pupil = AVSALxTPR	477.30	101
NTEXP	Non-teacher expenditures per pupil = CUREXP-TEXP	462.72	133
CUREXP	Total current expenditures per pupil	940.02	217
STFTRN	Rate of staff turnover	13.17	6.98
Exogenous variables			
V	Equalized property valuation per pupil	16795	11037
VRES	Residential valuation as a fraction of total property valuation	.448	.263
POWN	Percent of dwelling units owner-occupied, 1970	.592	.131
VOWN	Percent of property value owner-occupied, 1970	.7324	.1040
MFAMI	Mean family income, 1970	11,540	3,477

		Mean	Standard Deviation
LFAMI	Percent of families with incomes below $4,000, 1970	14.64	6.86
ED	Median years of schooling of the adult population, 1970	11.15	1.01
PCOL	Percent of adults who are college graduates, 1970	11.51	8.25
UE	Unemployment rate, 1970	3.48	1.30
OCINDEX	Opportunity cost index: mean earnings of college graduates in the county, 1970	1.00	.098
DEN	County population density, 1970		
PRISCH	Percent of children in private, non-parochial schools	1.52	2.51
PBLACK	Percent of ADA who are black	3.95	8.83
PCHIC	Percent of ADA who are Chicano	15.39	14.97
PORIEN	Percent of ADA who are Oriental	1.35	1.75
AGE518	Percent of population age 5 to 18, 1970	28.19	4.42
AGE65+	Percent of population over 65, 1970	10.02	5.04
ADA	Average daily attendance	13176	47090
ELADA	Elementary ADA as a fraction of total ADA	.692	.042
ELMOB	Pupil mobility, (enrollment/ADA), grades 1-8	.853	.090
TRAN	Student transiency ratio	.1806	.1545
TITL1	Title I aid per pupil	14.89	5.77
OTHFED	Other federal aid per pupil	61.01	77.86
SNCA	State non-categorical aid per pupil	246.13	77.64
SSEA	State special education aid per pupil	29.15	16.20
SEA	State categorical aid per pupil	3.32	4.62
OSA	Other state aid per pupil	21.55	18.99
COAID	County aid per pupil	11.31	14.60

Sources: All data is for 1971-72, unless otherwise noted. Wage and quality data are taken from Teachers Salaries and Salary Schedules 1971-72, Document No. 3, California Agency for Research in Education (Burlingame, Cal. April 1972). Other district data is taken from a computer tape of the state controller, Financial Transactions Concerning School Districts of California, 1971-72; and from the Fall Ethnic Survey, 1971-72 (Sacramento: State Department of Education, 1972). All 1970 data is from the 1970 Census of Population, School District Fourth Count Tape.

TABLE I

REDUCED-FORM EQUATIONS FOR WAGE MEASURES

	Dependent Variables				
	SBA	SBA5	SMA	SMA5	AVSAL
V	.0144 (.0028)	.0222 (.0038)	.0208 (.0037)	.0262 (.0045)	.0407 (.0067)
VRES	-933.1 (229.9)				
VOWN		-1229. (305)	-1045 (297)	-1450 (365)	-1410 (599)
ED	57.73 (28.59)	100.86 (38.72)	140.46 (45.18)	247.76 (53.16)	320.9 (81.9)
LFAMI	-10.82 (4.84)	-14.94 (6.56)	-18.33 (6.52	-16.72 (8.00)	-23.45 (12.87)
UE	-35.12 (17.63)	-25.41 (23.92)	-46.75 (23.82)		
AGE518					-41.33 -15.70
OCINDEX	1957 (265)	2741 (359)	2008 (352)	3364 (430)	4316 (620)
DEN	.0460 (.0219)	.0332 (.0255)			
ADA	.0022 (.0018)	.00309 (.00238)			.0140 (.0040)
ADA^2	$-.2809\times10^{-8}$ ($.2680\times10^{-8}$)	$-.5552\times10^{-8}$ ($.3604\times10^{-8}$)			$-.2143\times10^{-7}$ $.0605\times10^{-7}$
ELADA	1232.42 (529.49)	2305 (716)	3211 (712)	3271 (875)	
ELMOB	-362.44 (255.08)	-732.3 (346.6)	-1175 (347)	-1300 (426)	-849.3 (613.7)
TRAN			387.4 (229.7)	506.7 (282.0)	1186 (410)
PORIEN	-28.99 (14.84)				
OTHFED	.6157 (.3002)	.3122 (.4081)	.3584 (.4097)	-.2507 (.5033)	.2021 (.7063)

TABLE I con't

	SBA	SBA5	SMA	SMA5	AVSAL
TITL1	-.5285 (.41.5)	-.9888 (.5586)	-.6807 (.5608)	-1.177 (.685)	-1.461 (.984)
SNCA	.4835 (.3797)	.5991 (.5162)	1.023 (.518)	1.287 (.633)	1.155 (.913)
SSEA	.4468 (1.283)	2.133 (1.743)	1.920 (1.726)	6.257 (2.120)	10.76 (3.07)
SCA	-.2970 (.4.7306)	-1.821 (6.424)	-5.567 (6.409)	-11.86 (7.85)	-.8370 (11.31)
OSA	.9083 (1.270)	-.6222 (1.724)	-1.441 (1.714)	-3.235 (2.102)	-9.149 (3.031)
COAID	-1.650 (1.744)	-4.385 (2.359)	-.923 (2.345)	-3.053 (2.806)	-7.247 (4.147)
CONSTANT	4595 (713)	4430 (969)	4245 (1001)	3220 (1197)	5188 (1620)
R^2	.6035	.6389	.5596	.6445	.7060
S.E.E.	285.99	388.79	390.06	479.24	688.20

TABLE II

REDUCED FORM EQUATIONS FOR TEACHER QUALITY MEASURES

	PBA30	PBA45	P5YR	P10YR
V	$.2123 \times 10^{-5}$ ($.0800 \times 10^{-5}$)	$.3432 \times 10^{-5}$ ($.1053 \times 10^{-5}$)	$.1813 \times 10^{-5}$ ($.0840 \times 10^{-5}$)	
VRES	-.06096 (.04014)			
POWN	.1647 (.0525)	.1331 (.0744)		
PCOL	.001549 (.00953)			
LFAMI				-.00576 (.00150)
UE	.0115 (.0049)			
AGE518		-.003792 (.002177)		-.00967 (.00208)
TRAN	-.06485 (.04462)			.1275 (.0584)
PORIEN	.00977 (.00387)			
OTHFED	.0000914 (.0000855)	.000304 (.000115)	.0000450 (.0000892)	.000121 (.000109)
TITL1	.00104 (.00476)	-.0000196 (.000143)	-.0000267 (.0001148)	-.00207 (.00140)
SNCA	-.0000579 (.0001178)	-.000099 (.000145)	-.000220 (.000123)	-.000176 (.000120)
SSEA	.000441 (.000370)	.00145 (.00050)	.00101 (.00041)	.000979 (.000494)
SCA	-.000435 (.00136)	-.00136 (.00184)	.00115 (.00150)	.000537 (.001779)
OSA	-.00185 (.00037)	-.00208 (.00049)	-.000906 (.000412)	-.00154 (.00049)

TABLE II con't

	PBA30	PBA45	P5YR	P10YR
COAID	-.000260 (.000465)	-.000146 (.000609)	.0000780 (.0005031	.000186 (.000620)
C	.6492 (.0605)	.4980 (.0836)	.6841 (.0460)	.7965 (.0649)
R^2	.2659	.2257	.1555	.2750
S.E.E.	.0831	.1144	.0933	.1128

TABLE III

REDUCED-FORM EQUATIONS FOR MEASURES OF TEACHER-PUPIL RATIO

	ELTPR	SECTPR	TPR
V	$.1568\times10^{-6}$ $(.0533\times10^{-6})$	$.859\times10^{-6}$ $(.148\times10^{-6})$	$.3395\times10^{-6}$ $(.0554\times10^{-6})$
VRES	-.01730 (.00259)		-.01265 (.00245)
POWN			-.0121 (.00322)
PCOL		.000165 (.000148)	
MFAMI	$.2562\times10^{-6}$ $(.1547\times10^{-6})$		$.2320\times10^{-6}$ $(.1496\times10^{-6})$
AGE65+	.000241 (.000089)		.000237 (.000086)
ELADA	-.07447 (.01056)	.0576 (.0283)	-.0411 (.0100)
ELMOB			.00716 (.00469)
OTHFED	.0000173 .0000655	$.535\times10^{-5}$ (1.655×10^{-5})	.0000128 (.0000055)
TITL1	.0000689 (.0000721)	-.000328 (.000210)	-.0000439 (.0000761)
SNCA	.0000277 (.0000079)	.0000423 (.0000200)	.0000301 (.0000075)
SSEA	-.0000248 (.0000253)	.0000577 (.0000699)	$.3275\times10^{-5}$ $(.2402\times10^{-4})$
SCA	-.0000658 (.0000908)	.0000649 (.0002605)	-.0000491 (.0000865)
OSA	$.8157\times10^{-5}$ $(.2482\times10^{-4})$	.000330 (.000069)	.0000997 (.0000236)
COAID	-.0000828 (.0000313)	.000212 (.000087)	$.5940\times10^{-5}$ $(.2979\times10^{-4})$

TABLE III con't

	ELTPR	SECTPR	TPR
CONSTANT	.08110 (.00869)	.00669 (.02396)	.05860 (.00964)
R^2	.4669	.4470	.6440
S.E.E.	.00560	.0160	.00530

TABLE IV

REDUCED-FORM EQUATIONS FOR MEASURES OF EXPENDITURE PER PUPIL

	TCHEXP	NTCHEXP	CUREXP
V	.00699 (.00053)	.00820 (.00067)	.01376 (.00108)
VRES			-121.00 (59.35)
POWN	-283.3 (43.4)		-224.6 (105.7)
ED	7.980 (5.54)	13.57 (5.75)	
MFAMI	.00494 (.00170)		.01534 (.00293)
LFAMI	1.757 (.953)		
UE			-11.63 (5.91)
PRISCH		5.936 (2.170)	6.791 (3.153)
AGE518		-1.920 (1.342)	-8.570 (3.694)
AGE65+			-4.298 (2.550)
OCINDEX	172.27 (49.77)	232.85 (60.25)	
PBLACK		2.201 (.637)	3.242 (.927)
OTHFED	.1178 (.0576)	.4855 (.0704)	.5003 (.1039)
TITL1	-.1858 (.7353)	.3672 (.9249)	-.9634 (1.3413)
SNCA	.2025 (.0735)	.2274 .0933	.6235 (.1569)
SSEA	.5917 (.2492)	1.581 (.317)	2.647 (.462)

Table IV con't

SCA	-.4498 (.9208)	-.642 (1.158)	-1.974 (1.616)
OSA	.6599 (.2473)	1.416 (.312)	1.919 (.446)
COAID	-.4017 (.3296)	.5242 (.4023)	.1604 (.6027)
CONSTANT	166.07 (99.06)	-195.19 (97.95)	769.1 (113.6)
R^2	.7102	.7322	.8087
S.E.E.	56.38	71.16	98.97

FOOTNOTES

[1]See Grubb and Michelson (1974).

[2]Two early cases--McInnis v. Shapiro and Burruss v. Wilkerson--foundered because the courts were unable to cope with conceptions of equity which extended beyond expenditure equality.

[3]See Callahan, Willken, and Sillerman (1974). For an attempt to measure directly city-suburb cost differences, see Levin, Muller, and Sandoval (1973).

[4]For a review of some of the methodological problems in constructing cost indices for various types of expenditures, see Grubb (1976). The difficulties with construction costs are so great that Florida decided simply to centralize construction financing and decisions at the state level.

[5]In addition numerous state and programs compensate districts on the basis of teacher experience and degree levels. Though these could be construed as efforts to adjust for cost differences, it is historically more accurate to see them as incentives to upgrade teacher "quality." For a recent example in New Mexico, see Grubb (1976); for a general review of state programs see Johns (1972) or Tron (1976).

[6]This objection is probably most important in states with large number of small districts than in Florida, which has a small number of relatively large, county-wide districts.

[7]For a more detailed criticism of the Florida cost-of-living index see Fox (1975).

[8]The point of using such a model is to describe certain assumed consistencies in school district behavior, not to assert that districts actually have something like a utility function. The model developed here will focus on teacher hiring; for different versions of such a model, see Grubb (1975) or Grubb and Osman (forthcoming).

[9]For simplicity, we can think of W as the single wage rate in a district with all teachers of the same quality; this assumption will obviously be relaxed in the empirical work. Note that this is a model of district decision-making, and therefore the variables included are intended to represent the conceptions of local school officials and parents about the

process of schooling. Thus, for example, measures of quality are not necessarily those which would be significant in an educational production function, but are those teacher attributes which districts would like to obtain. Intergovernmental aid A represents non-matching aid only, since this is the only kind of aid which California distributes to local districts. in the more general cases where state aid includes matching aid, so that $S = m \cdot L + A$, the expression for the local tax rate in equation (1) should be $\frac{W \cdot N - A}{(1 + m) \cdot V}$.

[10]Note that the supply function includes the teacher-pupil ratio but not the number of teachers. The analysis could proceed with a different supply function, incorporating the number of teachers T:

$$h(N,W,Q,Y,T) = 0 \rightarrow h(T/P,W,Q,Y,T) = 0 \rightarrow h(N,W,Q,Y,N \cdot P) = 0$$

where P equals the number of pupils in the district. If we assume that the number of pupils is fixed at the time teacher hiring decisions are made, then the supply function h has the same theoretical content as the "collapsed" function g; it is then true that $g_1 = h_1 + P \cdot h_5$. It is somewhat simpler to use g rather than h, and the use of the teacher-pupil ratio rather than the number of teachers conforms better to the variables which are interesting to analyze. It is helpful in this analysis to think of supply and demand as being equilibrated by wage rate instead of by the number of teachers; equilibrium in the teacher labor market is defined when the wage offered for particular Q and N equals the wage necessary at the same Q for the number of teachers so that T/P = N to offer themselves to a particular district.

[11]These may be estimated by ordinary least squares. Equation (7) has been estimated by those attempting to analyze cost variations--including Brazer (1974), Clement and Gustman (1974), and Goffman, Kenny, and Denslow (1976)--as well as by a large number of researchers investigating the impact of unions on wages. A rather different analysis of salaries, quality and teacher-pupil ratios, focusing on the allocation of marginal resources assuming that revenues per pupil are determined prior to revenue allocation, is contained in Barro and Carroll (1975) and Alexander (1974).

[12]Complementarity is defined as $\frac{\partial^2 E}{\partial Q \, \partial N}$ greater than zero, while substitutability occurs when this cross-partial is negative.

[13]This corrects an egregious error in an earlier draft, pointed out by Harvey Brazer and Charles Troob. The method developed earlier for identifying the supply curve was as a consequence entirely bogus.

[14]Brazer and Anderson (1976) have made this assumption explicitly, though they attempted to test it by estimating a supply function. This assumption of perfect elasticity is used by Goffman, Kenny, and Kenslow (1976) to caluclate cost indices for Florida. One minor correction of their procedure is warranted: if teacher supply is wage elastic, then one would expect that even the error term in an equation for teacher salaries would represent shifts in supply among districts; and should therefore be included as an element in the cost index. The procedure used by Goffman, Kenny, and Denslow effectively omits the error terms from the cost index. Brazer and Anderson recognize that the error term could be included or excluded from a cost index by explicit choice.

[15]Brazer and Anderson (1976) have attempted to test the elasticity of teacher supply by estimating an equation of the form $W = f(N,S)$, where N is treated as an endogenous variable and instrumented, and the supply variables S are selected on an *a priori* basis. The coefficient of N is found to be insignificantly different from zero, leading them to conclude that the hypothesis of perfect elasticity is valid. But--comparing this specification to the reduced-form specification of equation (7), which we know can be validly estimated--the coefficient of N will include the effects of omitted demand variables, as well as the influence of the teacher-pupil ratio itself. The coefficient is therefore affected by this form of specification bias, and cannot be used to defend the hypothesis of perfect elasticity. Treating N as an endogenous variable does not solve this problem, which arises fundamentally from a lack of the kind of information and data that would permit specifying the supply function directly. Furthermore, since demand variables are consciously omitted from the "supply" function estimated by Brazer and Anderson, the coefficients of the supply variables may pick up the effects of omitted demand variables, to the extent that individual demand and supply variables are correlated. Hence their "supply" equation may not be accurate in describing the supply effects they want to isolate. In sum, there is no reason to think that they have not estimated a biased form of a reduced-form equation.

[16]See especially Goffman, Kenny, and Denslow (1976).

[17]The irony of this conclusion is exquisite, and rather humbling. Many of the recent efforts to construct cost indices--including those in this volume--were motivated in part by dissatisfaction with the assumptions underlying Brazer's (1974) separation of supply and demand variables. We can approvingly label such a procedure as the application of strong priors, or denounce it as ad hoc, but at the moment the necessity for doing so appears inescapable.

[18]In most districts, this is identical to having an M.A. degree.

[19]Congruence with the 1970 Census was one reason for collecting school district data for 1971-72 rather than some more recent year.

[20]Other variables which were tried but never proved significant included measures of the district occupational composition; the percent of children in parochial schools; various other measures of income; and a measure of a district's presumed monopoly in the local teacher labor market, defined as the number of teachers in a district divided by the total number of teachers in the county.

[21]See Frey (1973) and his brief literature review in Section I.

[22]Figures in parentheses are the standard errors of the coefficients. The specifications presented in these tables include only those variables which increase the explanatory power of the regression. For the development of a simple model--compatible with that of section II--which can be used to specify the variables used in these regressions, see Grubb and Osman (forthcoming). Intergovernmental aid variables have been included throughout for two reasons: there are a priori reasons for including them, since we know that intergovernmental aid flows to local districts and must therefore affect local fiscal decisions: and second, because of patterns in the distribution of intergovernmental aid, the possibility of specification bias arises if these variables are excluded.

[23]The decision to use a county rather than a district variable reflects the fact that teachers within a district can find alternative jobs in a labor market which is larger than the individual district. Others have used local variables to measure opportunity costs; e.g., Frey (1973) used an index of nursing salaries, while Clement and Gustman (1974) used a combination of nurses' salaries and the earnings of male

professionals. (Neither of these variables is available by county.) For a review of the effects of opportunity cost measures, see Frey (1976), Appendix A. Unfortunately the variable CINDEX is correlated with district mean family income, though not overwhelming so; the simple correlation between the two is .447. Hence it is difficult to be sure that CINDEX really measures the effects of opportunity costs rather than local socio-economic status.

[24]See Grubb and Osman (forthcoming) for a more careful argument for the first explanation, and evidence that a large school-age population does make a district more prone to allocate resources to schools as measured by a local revenues per adult and the tax rate.

[25]See Toder (1972), Goffman, Denslow, and Kenny (1976) and Brazer and Anderson (1976) found as we do the proportion non-white to be insignificant.

[26]But it still may be true that such patterns exist within more narrowly defined labor markets, like an SMSA. Toder's (1972) results on "battle pay" in districts with high black student population are based on a sample of Boston-area districts.

[27]The absysmal results for the "quality" measures in Table 2 cast some doubt on the assumption of perfectly elastic teacher supply. Clearly these are not "quality" measures; but equally clearly there are substantial salary variations among districts, unrelated to degree and experience levels. Arguments that the supply of teachers at a given degree or experience level is perfectly elastic may be valid. But if individual districts use different measures of quality--particularly if they have somewhat idiosyncratic measures in mind--then they may have to raise salary levels in order to attract a pool of applicants large enough to obtain a sufficient number of good quality teachers, as defined in their own terms. In other words, teacher supply may be perfectly elastic for teachers of equivalent quality as measured by the two attributes--experience and credentials--universally rewarded in salary schedules, but supply may be partially inelastic for teachers of similar quality as measured by other indices--e.g. verbal score, quality of undergraduate institution, and personal attributes of various kinds.

[28]A simple average is very close to the first principle component from a factor analysis of the four wage measures.

This component explains 89.5 percent of the variation in these four variables.

[29]If teacher salary structures were uniform among districts, then from the identity AVSAL = $\Sigma W_i Q_i$ a more precise index which allows only "quality" variation in the index could be constructed as $\Sigma \bar{W}_i Q_i$, where the $\bar{W}_i$ are statewide averages for the various wage rates. It would be rather difficult to make all salary schedules conform to one another, however; in addition, we have not collected data on all possible degree and experience levels, but only on a sub-sample of them.

[30]This factor explains 59.9 percent of variation in the four quality measures.

[31]As for indices Va, Vb, Vc, and Vd, we assume that UE, OCINDEX, DEN, ADA, ADA2, ELMOB, and TRAN reflect supply.

[32]The standard deviation is equivalent to the coefficient of variation in this case, since the mean of an index is one.

[33]Comparing the indices IVa,b, c, d and I (for AVSAL) with Va,b,c,d and VIII, the correlations are .612 for SBA, .629 for SBA5, .494 for SMA, .558 for SMA5, and .521 for AVSAL. In part these correlations are so low because Iva,b,c,d and I include error terms, and Va,b,c,d, and VIII exclude them since they cannot be identified as supply related. If both sets of indices are calculated with or without errors, the correlations increase to between .6 and .7. For a similar conclusion about the sensitivity of results to assumptions about supply elasticities, see Goffman, Denslow and Kenny (1974), section IV.

[34]That is, substituting in the expression for $\frac{df}{dC}$ from equation (13) into (14) yields an expression for $\frac{\partial A}{\partial C}$ which has L as one of its arguments--implying that "non-matching" aid has local revenue as one of its determinants, a logical impossibility.

[35]This section has benefited in particular from the comments of Charles Troob.

[36]See footnote 27 above.

[37]Staff turnover is significantly and negatively related to teacher salaries: the higher the salary level, the lower the rate of staff turnover. The regression for staff turnover--estimated by two-stage least squares because of the possibility of simultaneity, with AVSAL endogenous-- is:

$$\begin{aligned} STFTRN = & -.00255\ AVSAL \quad -.360\ PRISC \quad +.589\ POV \\ & (.00067) \qquad (.179) \qquad (.139) \\ & +.00443\ MFAMI \quad +\ 9.501\ CINDEX \quad -8.066\ TRAN \\ & (.000.68) \qquad (6.218) \\ & +\ 22.74 \\ & (6.94) \end{aligned}$$

$R^2 = .269$
S.E.E. = 6.07

If quit rates are a function of the salary structure, then the supply of teachers with high levels of experience is not perfectly elastic: in order not to lose some of their teachers with high experience levels, districts must raise salaries. Hence--at least for this one measure of teacher "quality"--teacher supply appears to be partly inelastic.

[38]The indices Iva,b,c,d, and e, IIa,b,c,d,e,f, and I include the variation due to unexplained error; indices Va,b,c,d, and VIII exclude the errors. See footnote 33 above. Brazer and Anderson (1976) have excluded errors, though implicitly recognizing that they might be included. Goffman, Kenny, and Denslow (1976) have excluded errors; see footnote 14 above.

[39]See the discussion in Brazer and Anderson (1976).

[40]This is a hypothesis; it could be tested by analyzing whether experience and degree levels are higher in those states which partially compensate districts for these teacher characteristics, relative to other states.

[41]But see Benson (1959) for one such attempt. Gerwin (1974) contains a number of articles on teacher hiring.

[42]One way to investigate variations in demand and supply of teachers would be to focus on the flow of newly-hired teachers, rather than on the stock of teachers in districts as was done in this (and every other) investigation of teacher salaries. This might also facilitate the investigation of rigidities

in teacher labor markets, and the effects of cycles in teacher supply on different districts. An alternative, in the absence of data on new hires, would be to construct a stock-adjustment model examining changes in salaries, quality, and teacher-pupil ratios, rather than the levels analyzed in all the work to date. Of course, the extension of teacher cost analysis to other states is an obvious application: to date results are available for California, Michigan, Florida, and New Jersey.

[43] It would be possible to test this supposition in Florida by calculating a variety of cost indices, as was done in section IV, and correlating them with the available cost of living index. Unfortunately Goffman, Kenny, and Denslow have not been able to make this comparison. They note, however, that the explanatory power of the cost of living index is lower than that of the independent variables available.

[44] The sensitive nature of cost corrections is evident in Florida, where efforts to adjust state aid by a cost of living index have been stalled in litigation brought by the low-cost districts.

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lower. Unless city life were sufficiently attractive to compensate for lower real incomes, the urban districts would be unable to hire qualified replacements for those retiring or moving. For this reason, the price-of-living index may be a good first approximation to an educational cost index. In fact, using standard regression techniques, we found the Florida price-of-living index explains 54 percent of the variance among counties in salaries for beginning teachers with bachelor's degrees in 1973 and 37 percent in 1974. Moreover on average counties paid teachers with bachelor's degrees salaries proportional to their price-of-living indices. That is, counties for which the index was 105 typically paid salaries five percent higher than those paid by counties in which the index was 100, while counties for which the index was 95 typically paid five percent less. We obtained similar results for teachers with master's degrees.

Despite these indications that the price-of-living index contains useful information about the cost of education, other states should not follow Florida's example by distributing the bulk of their assistance to school districts in proportion to similar indices. They would be ill-advised in doing this because the Florida index suffers from two serious biases. The first bias is that the index is higher in wealthier counties because of the near impossibility of controlling for variations among counties in the quality of goods and services. This is especially true of the housing and apparel categories, which together account for 83% of the variance in the 1974 Florida price-of-living index. If clothing of a given quality, for example, were truly substantially less expensive in poorer than in richer districts, as the index indicates, one would

expect teachers living in the latter to go shopping in the former, rather than vice-versa. But one suspects that stores in the wealthy urban districts of south Florida, with their higher quality and more varied stock, attract more out-of-county customers than do those in the poor rural areas in the northern part of the state. If the price-of-living index indeed falsely credits rich districts with much higher prices for housing and apparel than actually prevail, it by so doing incorrectly increases the state revenues available to the richer districts at the expense of the poorer ones.

A second and possibly even more severe bias comes from the omission, inherent in a price-of-living index, of any consideration of variations -- apart from those proportionally related to price levels -- in the relative desirability of living and working in different school districts. Teachers may be willing to accept lower real incomes to be near cultural centers, places of employment for spouses, or recreational areas. They may take lower pay in order to enjoy better weather or less exposure to crime. Moreover, both our research and that of others suggests that they prefer to instruct students with high social status and are willing to work for less in order to do so. The price-of-living index does not take account of the impact of these location- or school-related amenities on the real cost of teachers. One implication of this omission is that the state revenues going to districts whose students rank low in social status will not be enabled to compete equally in the market for teachers' services. Since low incomes, low "measured" prices, low social status,

and less desirable locations from a teacher's point of view commonly are found together, this failure to consider amenities probably augments the bias resulting from the likely over-estimation of prices in wealthy districts.

If states are to allocate funds according to an index which is an unbiased estimate of levels of prices of educational inputs, they especially need a way to determine how much particular districts must pay for teachers of a given perceived quality in view of their local prices, amenities, and student characteristics. Simply deriving an index of teachers' salaries from salaries now paid teachers of a given quality -- beginning B.A.'s, for example -- would be fruitless because districts would raise their salary schedules in order to obtain more state revenues. It is not unlikely that richer districts would raise their schedules more than poorer ones. To be useful, a cost-of-education index must be based on variables which are beyond the control of local school boards. Otherwise it will be biased according to the varying abilities of school districts to change it and may encourage wasteful expenditures.

In this paper we calculate an index of prices of educational inputs in Florida based on exogenous variables, that is, on measures not subject to local control or at least not easily changed. We concentrate on estimating the determinants of teachers' salaries, since most of the variation in our educational cost index comes from this component.

We assume throughout our analysis that the market for teachers' services is fully competitive. Our belief is that no school district would be able to reduce the salaries it pays teachers of a given perceived

quality by limiting the number of teachers hired. If a district were to attempt to reduce its salary schedule below the level competitively necessary, in view of its cost of living, level of amenities, and student characteristics, for obtaining its present quality mix of teachers' services, the average quality of teachers' services received by that district would quickly fall to the level appropriate to the lower salary schedule. This would happen first because the district would be unable to hire new teachers of the customary caliber to replace those normally resigning. The average county in Florida experiences a turnover in teachers of about ten prcent per year. Second, the school board would see a larger-than-usual exodus of its personnel from teaching. Many teachers are secondary workers -- that is, not the principal wage-earners in their families -- who will work at home if salaries decline. Empirical studies have discovered that the decisions of secondary workers to remain in the labor force or to leave it are very sensitive to wage changes. Third, a school board attempting to reduce salaries would find more than the normal proportion of its teachers moving to other districts. As these were replaced by recent graduates, the percentage of the district's teachers lacking experience would rise. Finally, those teachers remaining would have less incentive to improve their skills or impress their employers in hopes of gaining tenure or promotion. Acting in conjunction, these forces would cause the average quality of teachers' services to decline rapidly.

Several who have analyzed the market for teachers' services do not believe it is competitive. Exploring their arguments at length,

however, we found no convincing reaaon to abandon our asaumption that school districts cannot reduce wages without causing quality to decline. Thia turns out to be an important empirical issue, if indices of pricea of educational inputs are to be considered, since theae indices appear to be highly aenaitive to which asaumption is made. We have found this to be the case in Florida and other researchers have shown it to be true of California as well. This disagreement and its empirical significance lead ua to believe that more extensive efforts to resolve this iaaue ahould be undertaken before educational cost indices serve as a basis for distributing states' revenues.

Maintaining our assumption that districts are unable to lower the aalaries they pay for teachers' aervices of a given quality, we present a model in which aalaries in each district depend on the perceived quality of the teachers employed, the cost of living, the level of amenities available locally, and the characteristics of the schools and students. After developing the model we eatimated the effecta of these determinants of teachera' salariea uaing a number of regression equations. It is useful at this point to diacuss our resulta from theae regressiona, for which we used data representing the sixty-seven county achool districts in Florida in 1969-70 and 1970-71.

The perceived quality of teachera' services proves to be an eluaive concept empirically. We attempted to measure it with variables for teachers' average educational attainment, experience, aex, and race. Our expectationa were that on average teachers with maatera degrees and experience would earn more while women and blacks would receive leas. That

:hose with more education and experience would be expected to earn more
.s obvious. But our anticipation that the salaries of women and blacks
ıre lower may require justification. One would expect that women earn less
.han men because many of them are secondary workers. Planning to spend
nly a portion of their pre-retirement years in the labor force, many
'omen have less reason to work toward promotion and are likely to add
ess to their skills either through on-the-job training or through formal
ducation. While women are probably discriminated against with respect to
dministrative positions -- apparently none of the sixty-seven districts
n Florida had a woman superintendent in the early 1970's -- we have no
asis for judging the extent to which discrimination affects classroom
eachers. With respect to race, black teachers are expected to earn less
n average because they themselves were forced to attend inferior schools,
t least as measured by white educational goals. If anyone doubts this,
et him consider the fact that in 1960, after twelve years of separate
ut supposedly equal formal education, blacks attained only one-seventh
f the white average raw score on the Florida senior placement test.
iscrimination, if important, would further reduce their salaries.

Controlling for other variables, we found that a district which only
ires teachers with master's degrees pays its teachers about five thousand
ollars a year more than a district which hires none but teachers with
bachelor's degree. This does not mean that a teacher remaining in
particular county could have increased his salary five thousand dollars
year by earning a master's degree, since this degree was worth only

$850 on a typical salary schedule. What probably explains most of the higher average earnings of those with advanced degrees is that districts which hire higher percentages of teachers with master's degrees also employ teachers whose quality is superior in ways the measures we use fail to capture. An additional year of experience is also associated with an unexpectantly large increase in annual pay, just over a hundred dollars. Our regressions show that on average men earn about a thousand dollars a year more than women with the same degree. Since salary schedules permit no distinction by sex, districts with higher percentages of male teachers probably employ abler teachers of both sexes than do those with lower percentages. The average black teacher received only 78% as much as his white counterpart in 1969. This is a decided change from 1959, when Florida's schools were still segregated. According to regressions for 1959, at that time black and white teachers with the same formal education apparently received identical salaries.

In attempting to estimate inter-county variations in the cost of living, we drew upon recent developments in the theory of urban economics rather than rely upon the Florida price-of-living index. In this theory, differences in land prices are the principal determinants of geographical variations in the cost of living. A person working in Miami can buy clothes, books, and food imported from almost anywhere but must either rent or purchase Miami land or else pay the cost of commuting. Residential land is by its nature geographically immobile. For reasons elaborated in Section II, we use agricultural land prices and the percent of the population which is urban as measures of residential land prices.

We find that a doubling of land prices raises the cost of living and hence teachers' salaries about three percent.

Our findings regarding locational amenities are difficult to interpret because these amenities also affect the cost of living. In an area with good climate, for example, people are willing to work for lower real incomes. This causes locally produced services to be available more cheaply. Thus we cannot directly measure the values teachers attach to various locational amenities, since the same amenity which attracts teachers may also reduce the cost of living. Our results suggest that teachers value low crime rates and proximity to cities. Climate and proximity to the ocean seem not to matter. But climate varies little within Florida. Moreover, land prices (and thus the cost of living) are higher near the ocean. Therefore, our results could be interpreted as showing that teachers are willing to accept slightly lower real incomes (nominal income does not change) to be near natural recreational areas.

Our results indicate further that teachers in Florida are willing to accept lower salaries in order to work with abler students. We did not find them willing to take a reduction in income to teach smaller classes. But finding such an effect would be problematical in Florida, where there is little variation in average class size across counties.

These results from regression equations and their interpretation are elaborated in Section II below. One can have but little confidence in a model applied only to the data used in its derivation. It may perform well merely by accident. For this reason we test the strength of the model used in Section II by applying it to a different set of data, one representing Florida in 1959. The outcome of this test, which strengthens

our confidence in this model, is presented in Section III. In Section IV we test an equation developed by Harvey Brazer to explain variations in teachers' salaries in Michigan by applying it to data for Florida in 1960. His approach is also found to be robust, fitting the data for Florida as well as those for Michigan, although we disagree with his interpretation of his results. It is in this section that the empirical import of the debate over whether the market for teachers' services is fully competitive emerges.

Section V contains a preliminary index of the cost of educational inputs for Florida based on regression estimates of the determinants of teachers' salaries, secretarial salaries, blue collar wages, and transportable commodities. A hypothetical allocation of state revenues based on this index is found to differ noticeably from appropriations linked to indices derived from the Brazer model or to the Florida price-of-living index. Section VI closes the paper with a brief critique of the Florida price-of-living index. We conclude that if funds should be allocated in accordance with an index of educational costs -- a supposition we do not share -- then the Florida price-of-living index should be continued with a more restricted survey of prices and used to supplement an index based on regression estimates of the salaries teachers require to work in school districts of various types.

II. DIFFERENCES IN THE COST OF TEACHERS

The chief cause of variations among school districts in the salaries of teachers of a given perceived ability are variations in the cost and attractiveness of living in the different districts. Suppose a young person about to receive a master's degree in education, after exploring several possibilities, has visited and obtained job offers from two school districts, Richwood and Scrub Oak. He will probably attempt to learn not just which district pays the higher nominal salary but also what standard of living each salary will allow. In particular he may note that while Richwood provides a higher money wage, the cost of housing and services is so much greater there that his real standard of living would be lower than in Scrub Oak. Moreover in Scrub Oak, classes are smaller, allowing him to find more satisfaction in his work. But Richwood, which is near a large city, offers more enticing intellectual and social opportunities. Indeed he may find the choice a very close one and opt for one over the other on some seemingly trivial basis.

Let us more formally state our argument. Suppose now that Richwood is more pleasant or less costly to live in than Scrub Oak. If Richwood and Scrub Oak paid the same salary, our teacher would choose to teach in Richwood. Furthermore, Scrub Oak would be unable to attract teachers until it paid a salary sufficiently higher than Richwood's to compensate for the increased costs or lost pleasure associated with teaching in Scrub Oak. There are several types of amenities associated with teaching

in a particular school district. The most obvious are the conditions of work. A teacher might accept lower wages in order to work with more motivated or more intelligent children, to teach smaller classes, to teach pupils with backgrounds similar to his own, or to teach certain age groups. A teacher in a given school district must work every day in a particular location, and associated with that location are amenities, the level of which can be changed only through commuting. Since we have no way of knowing where teachers do reside and since living in an area away from a school district is achieved only with increased commuting and perhaps other costs, we will consider the relevant amenity level to be that found in the school district. Teachers may accept lower salaries in order to be near cultural activity, centers of employment for spouses, or recreational areas. Teachers' salaries may also fall with better weather or less exposure to crime. Finally the nominal salary teachers are paid will adjust, other things equal, to keep real income constant. That is, if District C is ten percent more expensive to live in than District B but otherwise identical, District C must pay a ten percent higher nominal salary to attract teachers.

A school district will be willing to pay more for a higher quality or better teacher. Individuals, through training in school and on the job, invest in themselves and hence increase their "quality." Using these arguments, the theory of human capital predicts that an individual's wage will rise with the level of schooling attained and with years of experience on the job.[1] Groups (such as the poor and blacks) who have

[1]Jacob Mincer, Schooling, Experience and Earnings, New York: Columbia University Press, 1974.

attended poorer quality schools have fewer resources invested in them and will thus command lower wages.[2] Groups (such as women) who spend less time in the labor force have less incentive and opportunity to invest in themselves; they will therefore have less training and will be paid less.[3]

Combining the above arguments, we have the following teacher supply function:

$$W = Pf(Q,A_1,A_2,\ldots,A_n) \qquad (1)$$

where W = nominal salary

P = index of prices teachers face

Q = teacher quality

A_1 = level of amenity 1

A_2 = level of amenity 2

A_n = level of amenity n

In writing the supply function in this manner, we assume that in the long run each district faces a perfectly elastic supply of teachers' services. Let us try to clarify this important assumption. It implies that in the long run real salaries paid teachers of a given perceived quality vary to compensate for differences in job- and location-specific amenities but do not reflect higher or lower levels of demand for teachers' services among districts. That is, a school district is assumed to be

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[2]Finis Welch, "Black-White Differences in Returns to Schooling", American Economic Review, LXIII (December 1973), 893-907.

[3]Solomon W. Polachek, "Differences in Expected Post-School Investment as a Determinant of Market Wage Differentials", International Economic Review, XVI (June 1975), 451-470.

unable to alter the wages it pays through changing the number of teachers it employs. This is illustrated by Figure 1, in which the supply of teachers to a district is given by curve S_1 and in which that district's demand for teachers is given by curve D_1. The real salary and the number

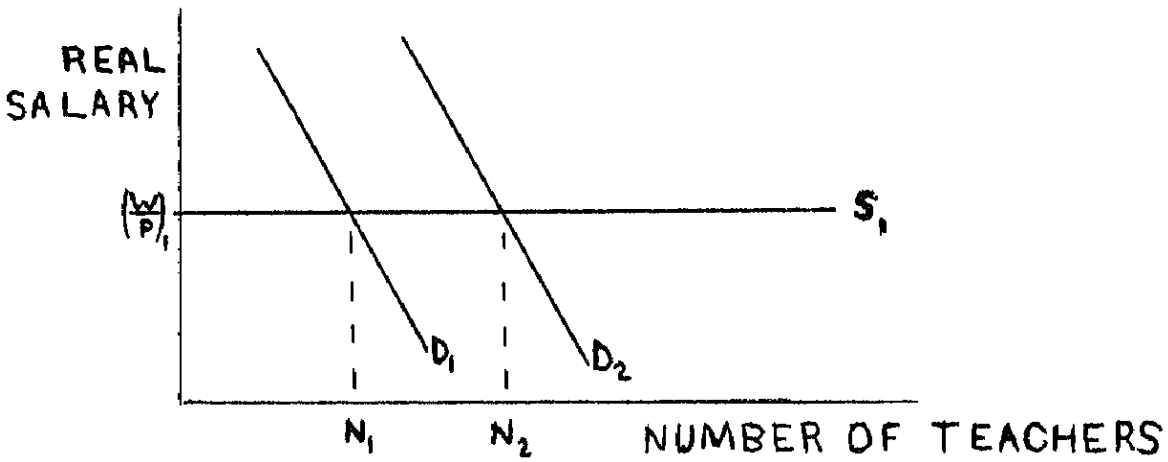

Figure 1

of teachers will be $(W/P)_1$ and N_1, respectively, as determined by the intersection of the supply and demand curves. If the demand for teachers were to shift from D_1 to D_2, but amenities did not change, then the number of teachers would rise from N_1 to N_2 but the real salary would remain at $(W/P)_1$.[4]

Our assumption that the supply of teachers' services to individual districts is infinitely elastic would not find universal support among students of the market for teachers' services. Because of the nature

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[4]Actually it is difficult to conceive of a realistic situation in which job-specific amenities would remain constant while the number of teachers increased. Assuming that the number of pupils in a district remains constant, class size would decline as the number of teachers increased, presumably causing the supply curve in figure one to shift downward and real salaries to fall.

of the data used, providing empirical estimates of the elasticity of supply is beyond the scope of this paper. But we believe that the elasticity of the supply curve is the central issue in the construction of educational cost indices. As we shall see below, educational cost indices are quite sensitive to the assumption made about the elasticity of the supply of teachers. Therefore, we think it useful to explain why we have adopted the assumption that supply is perfectly elastic as a maintained hypothesis in the empirical work which follows. The primary reason no one has yet successfully (in our opinion) estimated the elasticity of the supply of teachers' services for any set of school districts is that the conditions affecting demand and supply are entangled. Variables representing demand conditions are highly correlated with measures of supply. Were it otherwise the elasticity issue would be of little practical importance, since cost-of-education indices could be devised using supply variables alone. We believe that this multicollinearity among variables makes studies now available inconclusive. This inconclusiveness in empirical work forces us to rely on a mixture of impressions and data.

Admittedly, there are imperfections in the market for teachers' services, but upon examination, we conclude that these are not sufficient to cause long-run supply curves to have positive slopes. We cannot deny that both teachers and school districts are heterogeneous with respect to characteristics and preferences. For example, some teachers may have so strong a desire to live where they grew up that they would never consider moving but only whether to remain in education. Others may be drawn to a particular district because either they have relatives or

friends in the vicinity or they may have acquired information about that district while growing up or going to school near it. Further, as Grubb argues in an investigation of the determinants of teachers' salaries in California, districts may have such idiosyncratic preferences with respect to the characteristics they desire teachers to have that the supply of those particular characteristics may be limited.[5] This is an empirical issue, of course, but our belief from casual observation is that most districts have a fairly common notion of what type of person is a good classroom teacher. For all of these reasons, the supply curve may be upward sloping over an initial range, but we doubt that demand curves intersect the supply curves in this range except in rare cases.

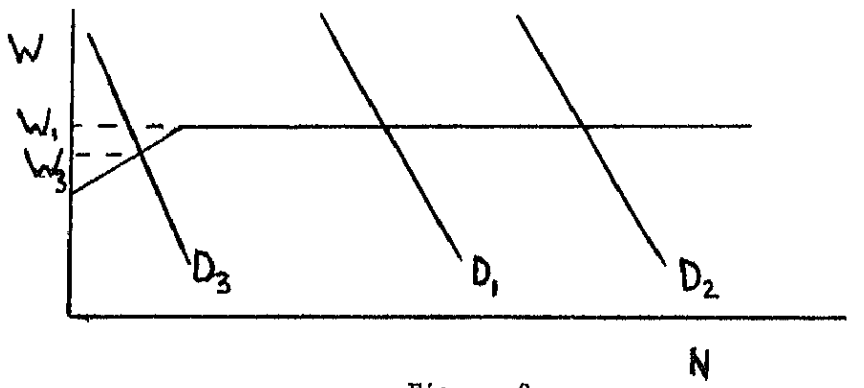

Figure 2

This is illustrated in Figure 2, in which demand curves D_1 and D_2 are associated with the same wage, W_1, while demand curve D_3, far to the left, is associated with a lower wage, W_3. Our contention is that a

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[5] W. Norton Grubb, "Identifying Teacher Supply Functions and Constructing Cost Indices: Methodological Explorations with California Unified School Districts," preliminary draft to the Office of Education under the terms of contract OEC-300-75-032, p. 33.

wage such as W_3 would seldom be observed. Grubb also argues that his finding that higher teacher-pupil ratios are associated with lower salaries implies that supply curves slope upward.[6] He employs a diagram similar to Figure 3 below to illustrate his point. An increase in the teacher-pupil ratio makes a district a more desirable place to work, and by making a district a more desirable place to work, an increase in the teacher-pupil ratio shifts the supply curve facing that district to the right. He argues that only if the demand curve intersects the

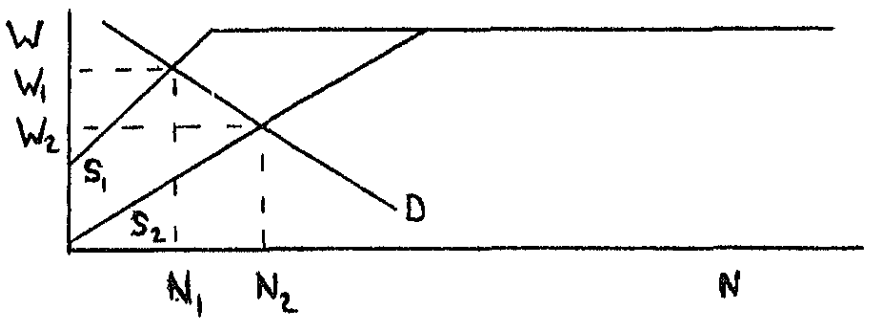

Figure 3

supply curve in its upward sloping portion will that rightward shift lower wages. However, Grubb overlooks the possibility that an increase in the teacher-pupil ratio "shifts" the horizontal portion of the supply curve downward.[7] Thus Grubb's analysis is invalid.

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[6]Grubb, "Teacher Supply Functions".

[7]We have placed the word "shifts" in quotation marks because of the identification problem noted earlier: the conditions of employment change simultaneously with a change in the number of teachers employed.

Until satisfactory empirical studies regarding the elasticity of the supply of teachers' services become available, we have no choice but to rely on our effort to interpret the fragmentary evidence at hand, which leads us to believe that a model based on infinitely elastic supply, such as our equation (1) above, best explains the market for teachers' services.

It would be tempting to estimate equation (1) as it stands. Antos and Rosen have done so.[8] However school districts are able to pick the quality of teachers they employ, the average class size, and perhaps a few other variables affecting teacher salaries, and this may introduce bias into the estimation of equation (1). One way of dealing with this bias is to estimate equation (1) for a constant quality level Q_o (e.g., estimate starting salaries for teachers with B.A.'s). An alternative way of dealing with this is to employ a two stage procedure (two stage least squares) whereby "predicted" values of the variables that are chosen by the school system (teacher quality, class size, etc.) replace actual values in the estimation. For a discussion of the model which specifies how school inputs are chosen and of its implementation in the two stage estimation, see Appendix C.

Such then is the theory. Now let us turn to the empirical estimation. The variables used are defined in Appendix B. All regressions were run for the sixty-seven county school districts in Florida. To escape problems caused by multi-year contracts most of the regressions reported use salaries

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[8] Joseph R. Antos and Sherwin Rosen, "Discrimination in the Market for Public School Teachers," Rochester 1974. (mimeographed).

averaged over a two year period. Table 1 presents ordinary least squares (OLS) and two stage least squares (2SLS) regression results with the average wage for all instructional personnel as the dependent variable. Table 2 presents ordinary least squares regression results for minimum salaries, maximum salaries, and a composite "average lifetime" salary for both B.A.'s (9-11) and M.A.'s (12-14). The explanatory power of the regressions (R^2) is high; in half the regressions at least 70% of the variance is explained. The standard error of the estimate (SEE) is close to $400. The standard errors of the regression coefficients are in parentheses below the estimated coefficients, and the dependent variable is given at the top of each column of regression results.

Several of our variables had no significant impact on teacher salaries in Florida. In particular, measures of the distance to recreational areas, the weather, deviations in the growth rate of the student body, the percent of teachers in junior high school, the racial composition of the student body, and the quality of teachers with B.A.'s all failed to explain teacher salaries. To simplify the discussion of our findings, we will report regressions where these variables have been deleted. In Appendix A, the full regressions are discussed.

Our measures of teacher quality generally perform as expected. Most of the variation in teacher quality occurs in Table 1 where the average years of schooling and of experience are allowed to vary. The percent of teachers with an M.A. (PMA) has a significant positive impact on salaries. As the percent of teachers with an M.A. rises by one percentage point the average annual salary rises by $44 to $60. The variable could also be interpreted as saying that an M.A. will command between $4437 and $5998 more per year in salary, but we believe that our estimates suffer from some

TABLE 1
Florida 1969-70 Teacher Supply Regressions

	1	2	3	4	5	6	7	8
	OLS Wage	2SLS Wage	OLS Awage	2SLS Awage	OLS Wage	2SLS Wage	OLS Awage	2SLS Awage
CONSTANT	5185.2**	6010.6**	6194.0**	7890.4**	5733.3**	6244.2**	6677.2**	8168.1**
	(1473.8)	(2061.1)	(1509.6)	(2122.3)	(1472.2)	(2073.1)	(1490.3)	(2117.2)
PMA	4603.1**	5534.0**	4834.4**	5998.4**	4436.9**	5534.7**	4683.5**	5941.6**
	(929.0)	(1444.6)	(951.6)	(1487.5)	(937.3)	(1454.8)	(948.8)	(1485.8)
EXP	122.6**	94.55*	111.35**	109.01**				
	(34.7)	(49.25)	(35.54)	(50.71)				
PC					1966.4**	1677.5**	1888.0**	1672.3**
					(589.2)	(810.6)	(596.5)	(827.8)
TEST	-24.975	-20.965	-34.451	-55.620	-17.392	-15.186	-28.194	-45.691
	(24.536)	(43.628)	(25.133)	(44.924)	(24.410)	(42.906)	(24.710)	(43.820)
TCHBLK	-2582.7**	-2530.9	-2645.7**	-3339.7**	-2077.7*	-2194.9	-2241.2**	-2753.4*
	(929.7)	(1539.8)	(952.3)	(1585.5)	(885.2)	(1440.3)	(896.1)	(1471.0)
CLSSIZ	60.396	14.268	47.936	10.206	9.669	-24.245	1.166	-35.463
	(41.662)	(64.783)	(42.675)	(66.707)	(40.908)	(60.691)	(41.411)	(61.983)
DCC	4.583**	4.718*	3.628	3.759	4.889**	4.771*	3.880*	3.828
	(2.151)	(2.427)	(2.203)	(2.499)	(2.166)	(2.447)	(2.192)	(2.499)
PMAL	129.80	-204.89	68.912	-593.19	716.84	517.89	635.37	224.26
	(1024.3)	(1697.2)	(1049.2)	(1747.6)	(1052.4)	(1680.8)	(1065.3)	(1716.6)
AGND	.841**	.865**	.906**	.980**	.723**	.760**	.796**	.864**
	(.185)	(.205)	(.190)	(.212)	(.188)	(.204)	(.190)	(.209)
ASLT	1.0587**	1.0769**	.99132**	1.0001**	1.0787**	1.1284**	1.0308**	1.0064**
	(.4544)	(.4998)	(.46544)	(.5147)	(.4620)	(.5080)	(.4676)	(.5188)
PURB	311.58	465.46	400.29	679.55*	493.33	615.51	573.00*	834.29
	(322.65)	(387.90)	(330.50)	(399.42)	(328.77)	(394.84)	(332.82)	(403.24)
DEN	-.120	-.105	-.080	-.095	-.041	-.048	-.011	-.022
	(.246)	(.257)	(.251)	(.264)	(.246)	(.254)	(.249)	(.259)
DEL	2810.4	1244.4	1587.3	814.4	1748.4	165.6	603.2	-417.50
	(2600.0)	(2953.4)	(2663.3)	(3041.2)	(2621.7)	(2931.6)	(2654.0)	(2994.0)
R^2	.719	.700	.706	.683	.713	.695	.707	.683
SEE	384	397	394	409	388	400	393	409

* Significant at .10 level
** Significant at .05 level

TABLE 2

Florida 1969-70 Teacher Supply Regressions

	9 OLS AWG3	10 OLS AWN3N	11 OLS AWN3X	12 OLS AWG2	13 OLS AWN2N	14 OLS AWN2X
C	9327.64** (1006.62)	7767** (564)	11016** (1660)	10284** (1338)	8974** (920)	11616** (1972)
TEST	-44.27** (16.94)	-32.41** (9.45)	-56.33** (27.95)	-39.71* (22.53)	-34.48** (15.48)	-45.02 (33.19)
TCHBLK	-1700.9** (568.6)	-1001** (319)	-2412** (938)	-1807** (756)	-1417** (520)	-2204** (1114)
CLSSIZ	-31.55 (27.30)	-17.33 (15.31)	-45.99 (45.03)	-48.41 (36.30)	-28.85 (24.95)	-68.29 (53.48)
DCC	1.613 (1.513)	1.889** (.849)	1.332 (2.496)	2.870 (2.012)	2.164 (1.383)	3.587 (2.965)
PMAL	1517.10** (726.66)	612.4 (407.4)	2437** (1198)	1207 (966)	201.3 (663.9)	2229 (1423)
AGND	.7681** (.1314)	.3717** (.0737)	1.171** (.217)	.7634** (.1747)	.3988** (.1201)	1.134** (.257)
ASLT	.90256** (.31203)	.45211** (.17492)	1.3604** (.5146)	.86709** (.41482)	.39277 (.28509)	1.3492** (.6112)
PURB	875.3** (228.2)	392.5** (127.9)	1366** (376)	943.7** (303.4)	426.4** (208.5)	1469** (447)
DEN	-.3203* (.1725)	-.0562 (.0967)	-.5889** (.2845)	-.3959* (.2293)	-.0507 (.1576)	-.7467** (.3379)
DEL	2583 (1761)	-115.3 (987.1)	5326* (2904)	4324* (2341)	-88.36 (1608)	8810** (3449)
SEE	273.3	153.2	450.8	363.4	249.7	535.4
R^2	.711	.575	.711	.616	.353	.678

our search.

Let us for the moment assume that the level of amenities is constant. The cost of producing some commodities will vary systematically across geographical regions. Housing-plus-access is an example of such a commodity. Suppose that land in the rural areas surrounding towns costs $X per year per plot. An individual working in the center of town always has the option of living in the urban/rural border and commuting into the center of town every day. Towns with larger populations tend to have greater commuting distances, and thus the total cost of housing-plus-commuting will be greater in large cities than in small towns. Therefore, as the population of a metropolitan area increases or as an area becomes more urbanized, the price of housing-plus-access will increase, increasing the cost of living. Similarly, as the base price of land in rural areas rises, the price of housing-plus-access will increase.

As a simple approximation, wages will adjust such that an hour's work will purchase the same basket of goods across different areas of employment. Thus, real wages are assumed to be constant. Workers will demand more to work in large cities, where the total cost of housing-plus-commuting is greater; the increased wages demanded in large cities will drive the cost of living up still further, and eventually this "multiplier" process will lead to equilibrium increases in wages and in the cost of living. To summarize our results, wages and the cost of living are predicted to rise with increases in urbanization, the population of urban areas, and the base price of land in rural areas.[10]

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[10]The regressions in Tables 1 and 2 provide one test of these predictions. In a further test of our predictions, the Florida Price of Living Index (FPLI) was found to increase significantly with increases in the per cent urban (PURB) and in the price of agricultural land (AGND). Variables measuring access to the Atlantic Ocean (DAT) and access to large urban areas (DCC) were also significant. These results are presented and discussed at length in the complete and more technical version of this paper available from the U.S. Office of Education.

AGND is positive and significant in every regression. A rise in the price of agricultural land by $1000 leads to a rise in teachers' salaries of between $400 and $1200. Since more educated teachers earn more and therefore require a larger absolute change in income to keep their real wages constant when the price level rises, we expect teachers with an M.A. to have a larger absolute rise in income in response to changes in the price of land than do teachers with a B.A. We do not observe this in these regressions; however in the full regressions our predictions are confirmed. PURB is always positive and is frequently significant. The regression coefficients indicate that as a county goes from completely rural to completely urban teachers demand between $300 and $1500 more per year to compensate them for the increased costs they incur. Our two measures of the cost of living are thus highly significant in explaining teachers' wages.

Thus far we have assumed that the level of amenities was constant. If the level of amenities is allowed to vary, everyone will be willing to work for less in a more pleasant area, and through the familiar multiplier effect, this will lead to a reduction in the cost of living and will decrease wages still further. Amenities arising out of urban economies of scale and associated with the level of exposure to crime are important location induced amenities. Because of economies of scale urban areas do offer benefits in the form of greater employment opportunities for spouses, lower retail costs (due to specialization), and greater cultural activity. For these reasons, teachers may accept lower wages in order to live in or near an urban area. DEN and DCC both try to capture these effects. As population density rises (DEN),

teachers' salaries fall; in several regressions in Table 2 the coefficient is significant. An increase in density by one standard deviation decreases salaries by between $3 and $200. Distance to the central city of the nearest SMSA (DCC) has a positive impact on wages. In several regressions DCC is significant, and in these regressions the coefficients indicate that as teachers move thirty more miles away from a SMSA, they require between $60 and $150 a year in compensation. There is some weak evidence that the value placed on access to urban areas rises with education or income. DEN is more negative for M.A.'s than for B.A.'s and DCC is more positive for M.A.'s than for B.A.'s. It also seems reasonable that teachers may require a larger salary to teach in a community with high exposure to crime. Moreover, they might be particularly sensitive to movements in the rate of aggravated assaults (ASLT). Because of problems associated with the reporting of rape, no measure of the incidence of rape was used. The incidence of juvenile arrest (DEL) was thought to be another measure of the exposure to crime that teachers face. ASLT always has the expected positive sign and DEL generally has a positive sign. ASLT is almost always significant, and DEL is sometimes marginally significant. A rise in the incidence of these crimes by one standard deviation is found to increase teachers' salaries by up to $260.

Our preliminary results indicate that two stage least squares does not offer any noticeable improvement over ordinary least squares. Apparently the bias attributable to the endogeneity of teacher quality, class size and pupil achievement is small.

III. A TEST OF THE MODEL: DETERMINANTS OF TEACHERS' SALARIES IN FLORIDA, 1959-60

A useful test of an econometric model is to apply it to data other than those used in its construction. For this reason we have attempted to explain variations in teachers' salaries among Florida's county districts in the 1959-60 school year with variables corresponding as closely as possible to those used in the 1969-70 regreasions reported in Tables 1 and 2. The results are presented in Table 3. The figures in parentheses below the coefficients are standard errors. The figures in the third row are t statistica calculated for testing whether the coefficients reported here are significantly different from those in the corresponding equations for 1969-70. The t statistic is positive if the coefficient is larger for 1969 than for 1959 and negative if it is smaller. In order to facilitate the comparison of coefficients the 1959 salaries used in these regressions were increased 26% to allow for inflation between 1959 and 1969.[11]

This comparison is a severe test of the model, since Florida changed markedly during the 1960's. The state's population rose 37%, about three-fourths of that increase being from net migration. A large portion of the school system became racially integrated. Per capita real income grew 51% while teachers' real salaries rose 42%. Nonetheless the proportion of the variance in teachers' salaries explained by these equations falls only slightly when they are estimated for data a decade older, from an average of 62% to an average of 60%, and even this decline is partly because one variable, juvenile delinquency, had to be dropped for lack of 1959 data.

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[11] The value of agricultural land was also increased 26 percent. In order to facilitate comparison, Monroe County (Key West) was omitted from these regressions. For 1959 the thousand acres in farms in the county was reported to have an improved value of $10,300 per acre, forty standard deviations above the Florida average of $219. Inclusion of Monroe County reduced the precision of the estimates and lowered the coefficients of AGND substantially. For 1969 the County and City Data Book gives no AGND value for Monroe County, so we used an estimated value near the Florida average.

TABLE 3: Florida 1959-60 Teacher Supply Regressions

	(1) OLS WN2N	(2) OLS WN2X	(3) OLS WG2	(4) OLS WN3N	(5) OLS WN3X	(6) OLS WG3	(7) OLS WAGE
TEST	4.87	2.81	1.64	3.18	3.40	3.28	-1.51
	(4.02)	(4.68)	(3.92)	(3.68)	(3.66)	(3.17)	(8.40)
	-2.44**	-1.42	-1.80*	-3.17**	-2.10**	-2.74**	-.31
BLACK	-8	-42	16	43	162	59	672
	(244)	(284)	(238)	(223)	(221)	(192)	(630)
	-2.44**	-1.93*	-2.28**	-2.66**	-2.65**	-2.91**	-1.81*
CLSSIZ	11.7	-13.1	-.6	-10.2	-33.6*	-21.8	-63
	(20.5)	(23.9)	(20.0)	(18.7)	(18.6)	(16.1)	(171)
	-1.25	-.94	-1.15	-.29	-.25	-.31	-.21
DCC	2.73	1.67	2.77	-.18	.02	-.08	-1.91
	(1.75)	(2.04)	(1.71)	(1.60)	(1.60)	(1.38)	(6.35)
	-.25	.53	.04	1.13	.44	.82	.97
PMAL	2730*	2507**	2620**	2266**	1492**	1882**	28
	(753)	(897)	(736)	(690)	(687)	(595)	(2232)
	-2.50**	-.17	-1.16	-2.05**	.70	-.39	.03
AGND	.178	.737**	.455**	.082	.659**	.368**	.427*
	(.137)	(.159)	(.133)	(.125)	(.125)	(.108)	(.244)
	1.20	1.30	1.39	1.98**	2.03**	2.33**	1.04
ASLT	.92	5.74**	3.31**	1.23	4.23**	2.72**	2.02
	(1.52)	(1.77)	(1.48)	(1.40)	(1.38)	(1.20)	(3.41)
	.34	-2.34**	-1.58	-.55	-1.93*	-1.46	-.26
PURB	460**	439**	450**	338**	301**	319**	450
	(160)	(186)	(156)	(146)	(146)	(126)	(636)
	-.13	2.11**	1.44	.28	2.62**	2.12**	.22
DEN	-.277	-.224	-.253	-.157	-.216	-.186	-.014
	(.190)	(.221)	(.185)	(.174)	(.172)	(.150)	(.346)
	.91	-1.29	-.48	.50	-1.11	-.58	.32
PMA							2361
							(1127)
							1.72*
PC							91
							(771)
							1.41
CONSTANT	3432	5428	4422	3591	5985	4778	6476
SEE	211	246	206	193	192	167	257
R^2	.428	.713	.639	.411	.740	.665	.586

Significance levels
*10%
** 5%

The variables whose coefficients are consistently significant in the 1959-60 regressions are the average value with improvements of an acre of agricultural land (AGND), the proportion of the population living in an urban area (PURB), reported cases of aggravated assault per 100,000 population (ASLT), and the proportion of teachers who are male (PMAL). The coefficients of AGND and PURB, variables which serve primarily as proxies for the cost of living, are lower for 1960 than for 1970, often significantly so. About half of the increase in the effect of AGND and PURB between 1960 and 1970 can be explained by the growth of teachers' real salaries.[12] Salaries rise by α percent to compensate for an α percent rise in the cost of living. Thus, a larger absolute increase in salaries is required to increase salaries by one percent when salaries are high. The fact that these coefficients have risen by more than expected suggests that prices may be non-linearly related to AGND and PURB or that the way in which they are related may have changed.

The coefficients of ASLT fell between 1960 and 1970, significantly so in two of the regressions. Because of limitations of the data available we were forced to construct this variable in 1960 with no information about individual rural counties. It is not at all clear, therefore, what this change in coefficients means. The coefficients of PMAL are lower for 1969 than for 1959, significantly so in the regressions in which wages of beginning teachers are the dependent variables. By these estimates women seeking their first teaching positions in 1959 could have expected to earn 63% as much as their male counterparts with a B.A. or 60% as much with an M.A. For 1969 the figures are 91% and 7% respectively. This change is in keeping with modifications in the role of women during the 1960's which led women to work more and to invest more in themselves.

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[12] This rough estimate is based on the average of the logarithmic ratios of coefficients compared to the logarithm of the ratios of real salaries, a technique which probably provides a better approximation than using simple ratios.

The coefficients of CLSSIZ have the wrong sign (negative) and are insignificant in the 1959-60 regressions just as they were in the 1969-70 regressions chosen for re-estimation. CLSSIZ has very little variance, the standard deviation being approximately two in both years, with average class size being 21 or 22. The coefficients of DCC, significant in two of the repeated 1969-70 regressions, are always insignificant in the 1959-60 set. This loss of significance may stem from the fact that Florida at the earlier date had fewer standard metropolitan statistical areas. Such could easily be the case if the relationship between the required salary premium and distance is non-linear.

The coefficients of TEST, a measure of perceived pupil quality, were positive, the wrong sign, in all cases but one and were always insignificant in the 1959-60 regressions. This contrasts with the 1969-70 regressions in which the coefficients of TEST were often significantly negative, as expected. Since test scores were scaled independently for black students and white students in 1960 while there was a common scaling in 1970, we tried several adjustments of the raw data in an effort to improve the comparability of the measures. None affected the coefficients noticeably. The version reported is an average of the independently scaled (i.e., identical means and standard deviations) black and white averages, weighted by the number of each taking the test.

In 1960 blacks obtained average raw scores one-seventh of those of whites on the Florida senior placement test. Though this gap probably narrowed between 1960 and 1970, it is unlikely that it was eliminated. Since the 1970 test was not scaled independently for blacks and whites, the county averages for that year may be a proxy for the proportion of students who were black. Thus, the negative coefficients for this variable in 1970 may be reflecting the effects of discrimination. But the full 1970 regressions reported in Table B-2

fail to support this interpretation. In those regressions, in which the proportion of students who are black is included aa an independent variable, the coefficients of TEST remain negative and are often significant. Hence, we aee the decline in these coefficients between 1960 and 1970 as evidence not of racial discrimination but that teachers have a high income elasticity of demand for classes of able and motivated students.

The variable BLACK, which in the 1959-60 regressions is the proportion of seniors taking the Florida placement teat who were black, is difficult to interpret. Presumably BLACK is highly correlated in 1960, when all high schools in Florida were segregated, with the proportion of teachers who were black. We have compared its coefficients, therefore, to those for TCHBLK in the 1970 regressiona. Our tentative deduction from the significant decline in those coefficients is that the relative salaries of blsck teachers fell during the 1960's. By this interpretation, the expected salary of a black four-year college graduate aeeking a first teaching position, for example, is estimsted to have fallen from 100% of that expected by his white counterpart in 1959 to 78% in 1969. We emphasize, however, that we are not confident thia is the correct explsnation of our resulte.

In summsry, our conclusions from thia comparison of the determinants of teachers' salary differentials in 1959-60 and 1969-70 in Florida are that the relative salariea paid women have risen while those paid blacks have fallen, and that the income elasticity of teachers' demand for working with able atudents is high. The changes in the coefficients of the vsriables serving as price-level proxies auggest that, while we sre on the right track in the selection of theae variablea, further work in obtaining a better functional form may be helpful. Thus we have seen many changes in the 60's. This auggeats that from time to time reviaions to a cost of education index may be

beneficial. Of course, with any revision, there are losers and gainers and thus conflict. There may therefore be a substantial cost associated with revision. The benefits and costs associated with revision will have to be weighed.

IV. A COMPARISON OF THE DETERMINANTS OF TEACHERS' SALARIES IN FLORIDA AND MICHIGAN

As part of our study of the market for teachers' services in Florida, we have applied Harvey Brazer's model of the determination of teachers' salaries, which he developed using data for Michigan,[13] to the sixty-seven county school districts in Florida. This application, besides serving as a test of the generality of Brazer's model, may through comparison bring out aspects of the market for teachers in Florida which would otherwise be overlooked.

Brazer assumes that the salary paid teachers of identical quality in a given district results from the interaction of demand and supply. He estimates a reduced-form equation containing seven variables said to affect demand and eight said to affect supply. On the demand side he has extra-voted millage (MILLV), the proportion of the population not born in the United States or whose parents were born elsewhere (PFOR), the proportion of the population aged five and older who lived in the same house as five years before (STAY), and the proportion that kindergarten through grade 12 public school pupils represent of the total population (PPUPOP) as variables representing greater willingness to support public schools. Still on the demand side, the state equalized value of taxable real and personal property

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[13] Harvey Brazer, "Adjusting for Differences Among School Districts in the Costs of Educational Inputs: A Feasibility Report," in Selected Papers in School Finance, 1974, a publication of the Department of Health, Education and Welfare; Esther O. Tron, Project Monitor, U.S. Office of Education.

per pupil (SEVP) and the proportion of families whose annual income was $15,000 or more (PRICH) are direct measures of the ability to pay for education.[14]

As supply variables for each district Brazer has three measures of how teachers will appraise students and three dummies for the rural urban continuum. Used as indicators of teachers' perceptions of student quality are the drop-out rate for pupils in grades 9 through 12 (DROP), scores on a standardized examination (TEST), and the proportion of the population that is non-white (PNW). The dummy variables for location are central city of a standard metropolitan statistical area (SMSA), suburb of a central city (SUB), and no city in the district that has a population of 4,000 or more (RUR). A classification as independent city for districts not within a SMSA but containing a city of 4,000 or more is the suppressed dummy variable.

Finally the model contains two measures of teacher quality, average years of teaching experience (EXP) and the proportion of teachers who hold masters or other advanced degrees (PMA). Uncertain whether these should be classified as supply variables or demand variables, Brazer offers alternative indices, one for each case. In keeping with our explanation in section two, we will treat them as demand variables, indicating a different quality of service purchased.

Parameters obtained from applying this equation to 1969-70 average teachers' salaries (ATS) in Florida are given in Table 4, along with Brazer's values for Michigan. In each case the fitted equation explains 73% of the variance in salaries among districts and the patterns of coefficients and elasticities are similar. In fact the difference between coefficients is not statistically significant at the 10% level for any single variable. In

[14] Brazer also included the proportion of the local tax base that consists of residental property (RES) as an inverse measure of demand. Since Brazer found RES to have an insignificant coefficient, we did not construct a similar variable for Florida.

TABLE 4: The Brazer Model Applied to Michigan and to Florida, 1969-70

VARIABLE	MICHIGAN COEFFICIENT	t-stat	Mean	Elast	FLORIDA COEFFICIENT	t-stat	Mean	Elast	t-diff
MILLV	31.86	1.82*	16.36	.036	-13.85	-.31	9.75	-.017	1.15
SEVP	.0243	2.16**	20,150	.041	.0139	1.83*	24,704	.042	.55
RES	3.531	.59	49.2	.014	-	-	-	-	-
PFOR	27.35	2.51**	17.7	.041	49.87	4.14**	8.06	.050	1.17
STAY	17.86	1.98*	55.9	.085	25.86	2.69**	48.5	.155	.50
PRICH	26.99	2.97**	26.7	.061	31.80	1.71*	11.1	.044	.01
PPUPOP	62.50	2.68**	25.5	.135	30.34	1.16	21.1	.079	.78
EXP	155.3	3.90**	8.8	.116	46.25	1.20	9.4	.054	1.58
PMA	37.24	4.32**	29.6	.093	26.32	2.33**	25.2	.082	.70
DROP	42.98	1.69*	5.2	.019	14.96	1.84*	12.1	.022	.67
TEST	-58.22	-1.49	51.1	-.252	-8.70	-.43	57.8	-.062	.76
SMSA	752.7	2.29**	-	-	273.1	1.46	.15	.005	.88
RUR	-429.3	1.77*	-	-	-152.0	-1.03	.34		.68
SUB	136.4	.59	-	-	404.0	1.34	.03		.64
PNW	7.729	.86	4.6	.003	-12.98	-1.57	19.1	-.031	1.33
MEAN WAGE	11,811				8,089				
R^2	.72	n = 177			.72	n = 67			
SEE	818	OLS			390	OLS			
CONSTANT	7004				4790				

Significance levels
* 10%
** 5%

this sense our application of Brazer's equation to Florida shows it to be general. Apparently the markets for teachers' services in the two states are rather alike. But while our findings confirm Brazer's statistically, our interpretation of them varies from his because our assumption about the competitiveness of the hiring of teachers differs from his.

Because of this discordance we find it helpful before entering a variable-by-variable comparison of coefficients to illustrate the empirical significance of the larger issue of whether each district as it contracts teachers faces an upward sloping supply curve, as Brazer assumes, rather than a perfectly elastic supply, as we suppose. We do this by applying Brazer's index to the parameters obtained fitting his equation to Florida data.

To calculate an index for district i, Brazer first forms an estimated teacher supply salary, $\hat{S}_i$, as

$$\hat{S}_i = \hat{\alpha} + \hat{\beta}\overline{X} + \hat{\gamma}Y_i,$$

where $\hat{\alpha}$ is the estimated value of the constant term in the regression, $\overline{X}$ is a vector of the weighted mean values of the demand variables, Y_i is a vector of the supply variables for district i and $\hat{\beta}$ and $\hat{\gamma}$ are the corresponding vectors of coefficients. Forming $\hat{S}_i$ in this way allows for variations in amenities while holding the level of demand for teachers' services and the perceived quality of teachers constant. The index is

$$I_i = 100\ \hat{S}_i/\overline{S},$$

where $\overline{S}$ is the weighted average salary.

Two variants of this index are given for Florida counties in Table 5. In the first (WIND), EXP, PMA, MILLV, SEVP, PFOR, STAY, PRICH, and PPUPOP are all considered to be demand variables in accordance with one version of

TABLE 5: Indices of Teachers' Salaries for Florida, 1969-70*

COUNTY	(1) WIND	(2) SIND	(3) IND DIFF	(4) SAL DIFF	(5) n of TEACHERS	(6) TOTAL DIFF
Dade	100.33	114.41	-14.08	-1243	12383	-15395
Broward	100.57	105.38	-4.81	-425	6518	-2768
Palm Beach	99.93	104.58	-4.65	-411	3582	-1471
Sarasota	98.53	100.62	-2.09	-185	1048	-193
Charlotte	97.83	99.72	-1.89	-167	236	-39
Collier	100.07	100.95	-.88	-78	502	-39
Pinellas	100.73	100.77	-.04	-4	4420	-16
Flagler	94.12	92.58	1.54	136	63	9
Lafayette	95.29	89.34	5.95	525	40	21
Liberty	98.50	92.95	5.55	490	53	26
Jefferson	91.31	88.83	2.48	219	138	30
Glades	93.13	86.56	6.57	580	59	34
Gilchrist	98.51	90.03	8.48	749	62	46
Indian River	97.10	95.66	1.44	127	430	55
Martin	96.91	95.06	1.85	163	350	57
Taylor	96.89	93.42	3.47	306	186	57
Hendry	95.34	91.10	4.24	374	159	60
Dixie	97.65	88.32	9.33	824	88	72
Franklin	100.24	91.59	8.65	764	98	75
Baker	98.03	90.89	7.14	630	125	79
Wakulla	95.94	85.74	10.20	901	92	83
Calhoun	95.05	86.72	8.33	736	116	85
Citrus	96.98	92.80	4.18	369	229	85
Hamilton	92.97	86.07	6.90	609	143	87
Union	95.36	80.56	14.80	1307	73	95
Hardee	100.23	94.23	6.00	530	185	98
Madison	92.47	85.92	6.55	578	174	101
St. Johns	98.00	94.93	3.17	280	363	102
Gulf	95.34	88.04	7.30	645	161	104
Walton	98.87	92.30	6.57	580	192	111
Holmes	101.26	91.75	9.51	840	134	113
Washington	95.41	87.48	7.93	700	171	120
Osceola	98.60	93.79	4.81	425	290	123
Hernando	98.09	91.76	6.33	559	223	125
DeSoto	98.13	89.49	8.64	763	169	129
Okeechobee	101.89	91.90	9.99	882	146	129
Levy	95.69	87.77	7.92	699	195	136
Sumter	97.90	90.20	7.70	680	200	136
Suwanee	97.55	91.18	6.37	562	241	136
Highlands	96.99	91.77	5.22	461	334	154

Table 5

COUNTY	(1) WIND	(2) SIND	(3) IND DIFF	(4) SAL DIFF	(5) n of TEACHERS	(6) TOTAL DIFF
Brevard	97.32	96.43	.89	79	1986	156
Bradford	96.88	88.50	8.38	740	222	164
Nassau	96.68	90.10	6.58	581	296	172
Monroe	98.99	94.76	4.23	373	513	192
Manatee	98.16	95.36	2.80	247	916	226
Columbia	96.95	89.05	7.90	696	330	230
St. Lucie	95.98	91.15	4.83	426	541	231
Putnam	95.90	89.76	6.14	542	501	272
Okaloosa	98.27	88.27	10.00	883	320	283
Volusia	97.40	95.23	2.17	192	1613	309
Lake	97.71	93.43	4.28	378	839	317
Gadsden	93.30	85.96	7.34	648	507	329
Jackson	96.45	87.79	8.66	765	452	346
Pasco	100.36	93.23	7.13	630	599	377
Clay	98.33	89.08	9.15	808	475	384
Marion	97.14	92.25	4.89	432	892	385
Lee	99.46	95.19	4.27	377	1112	419
Santa Rosa	102.95	93.56	9.39	829	514	426
Seminole	101.17	95.05	6.12	540	991	536
Bay	97.83	89.04	8.79	776	861	668
Leon	98.25	91.00	7.25	640	1152	737
Alachua	100.50	92.28	8.22	726	1077	782
Polk	97.91	92.83	5.08	449	2729	1224
Hillsborough	100.76	97.91	2.85	252	4975	1252
Orange	100.30	96.29	4.01	354	4036	1429
Escambia	99.84	92.07	7.77	686	2374	1629
Duval	99.30	93.98	5.32	470	5711	2683

* WIND: Index formed from the Florida regression in Table 4 assuming EXP, PMA, MILLV, SEVP, PFOR, STAY, PRICH, and PPUPOP are demand variables. SIND: Index formed from the Florida regression in Table 4 assuming only EXP and PMA are demand variables.

Brazer's assumptions. In the second (SIND), only EXP and PMA, the measures of teacher quality, are considered demand variables, in keeping with our assumptions. The third column presents the difference between the two indices, while the fourth gives the gain (+) or loss (-) per teacher in 1969-70 in each county from using Brazer's assumptions instead of ours. This number multiplied by the number of teachers, listed in column five, equals the total gain (+) or loss (-), given in column six in thousands of dollars, to each county from allocating funds by Brazer's assumptions rather than ours.

It is clear from Table 5 that the assumption of perfectly elastic supply to each district of teachers of a given quality would result in the allocation of more funds to counties along the southern coast -- and especially to the third of the state's population in the urban area which includes Miami (Dade, Broward, and Palm Beach counties) -- at the expense of most of the rest of the state. For Florida the issue may be restated as: To what degree, if any, are the higher salaries paid teachers in the urban area along the Atlantic southern coast due to a greater demand there for teachers? We think it likely that the demand for teachers' services is in some sense higher in Dade, Broward and Palm Beach counties than in the rest of Florida. As a crude measure of this, real median income (adjusted by the 1973 Florida county price level index) is 7% higher in those counties than in the rest of the state. The fact that the average score on the standardized placement test taken by 12th graders is 10% higher in those counties than in the rest of Florida may be partly a result of greater investment in education there. But in our opinion this greater demand has little effect on salaries paid teachers of a given perceived quality.

In view of the considerations elaborated in Section II above, we believe the coefficients of Brazer's demand variables represent their impact on supply, not demand. The variables themselves may cause both supply and demand to shift,

but if supply is perfectly elastic, the effect on demand will not be captured by their coefficients since, as shown in Figure 1, a shift in demand would not cause salary, the dependent variable, to change. One expects SEVP and PRICH, for example, to be positively correlated with the cost of living, since if real property values and incomes were equal in two districts, the measured (nominal) values and incomes would be higher in the area with higher prices. In line with the values estimated for Florida, it is quite plausible that a 25% increase in both the value of property per pupil and the proportion of the population with incomes of $15,000 or above would, other things the same, be accompanied by a 2% increase in the cost of living which in turn, according to the unitary coefficients we obtained in logarithmic regressions of salaries on the price level index, would induce teachers to require 2% higher nominal salaries.

By our interpretation the coefficient for PFOR indicates Florida teachers must be paid an extra $250 a year to teach in a county which has, on average, one more Spanish-speaking student per class of twenty. This estimate strikes us as high, and we have included no variable similar to PFOR in our own model because of its high correlation with whatever else may be peculiar to southern Florida. MILLV is a fully endogeneous variable which may be chiefly a measure of the elasticity of demand for teachers' services. If the teacher supply curve shifts up and if the demand for teachers is inelastic, the total salary bill will be higher and taxes will have to be raised. Alternatively, if the demand for teachers is elastic and the supply curve shifts up, the total salary bill will be lower and taxes

can be reduced. We doubt, however, that much can be deduced from the insignificant MILLV coefficient in the Florida regression.

STAY and PPUPOP are difficult variables to interpret. Brazer suggests that those in settled neighborhoods, having stronger local ties, will provide more support for schools. It is hard for us to see just why such local ties would lead people to spend more on the education of their children. The connection between the two appears tenuous. An alternative explanation of STAY's positive coefficient is that teachers may require more to work in slowly growing districts where opportunities for promotion and tenure are lower. PPUPOP is similarly problematical. It represents the product of the ratio of school-attending to total population and the proportion of those attending school who go to public schools. One reason for the positive coefficient could be that when teachers' salaries are high in a given district then, other things equal, the relative price of private school is high, and a smaller fraction of pupils attend private school. Another reason for the positive coefficient could be that pupil achievement and family size are negatively correlated. Teachers would require more to instruct pupils who come from larger families and hence achieve less. The fertility literature suggests that a negative trade-off exists between family size and pupil achievement; this trade-off has been documented in a number of studies, many of which have been cited in the reference given in footnote 31 above.

EXP and PMA, the variables representing teacher quality, have the expected positive coefficients for Florida. Each extra year of experience boosts

[illegible]ty dollars, rather less than the $150 estimated

for Michigan. A master's degree is "worth" $2600 a year in Florida, less than the $3700 found for Michigan but approximately the same percentage increase. In both Michigan and Florida, PMA is probably correlated with unobserved measures of teacher quality. And for both EXP and PMA, it will be recalled, the difference in coefficients is statistically insignificant.

The coefficients of DROP and TEST, two of the measures of pupil quality, also have the expected signs, though the effect of each on salaries appears to be weaker than in Michigan. Perhaps a class of high-quality students, as measured by those two variables, is a luxury good, as hypothesized above in section three. Better-paid teachers may be willing to give up higher proportions of their incomes in order to work with motivated and able students. This raises the possibility that if teachers' real incomes rise, obtaining instructors for districts with difficult pupils will become relatively more costly. Since PNW, the third measure of perceived pupil quality, is highly correlated in Florida with the proportion of teachers who are black, an important non-included measure of perceived teacher quality, we attach no significance to its coefficient in this regression.

The coefficients of the urbanization dummies have the same signs in both regressions. Salaries are higher in cities and suburbs and lower in rural districts for many reasons, including the higher cost of living in urban areas.

In summary, our results using this equation confirm Brazer's, but our interpretation of these results is not the same as his. The comparison of the two indices formed from the two interpretations of Brazer's model as applied to Florida suggests that the elasticity of the supply of teachers' services facing individual school districts is one of the major issues involved in the allocation of educational resources.

V. A PRELIMINARY INDEX

The formulation of an index of the prices of educational inputs, though logically subsequent to the full testing and revision of the explanatory model used as the basis for that index, can be a fruitful exercise even at an early stage of the development of that model. A preliminary index can be used for approximate sensitivity tests of the importance of different choices of variables and divergent interpretations. An example of this use of such preliminary indices is in Section IV above, where designating some of the coefficients in Brazer's equation to be supply rather than demand effects was found to change a hypothetical allocation of funds by $19.5 million in Florida in 1970.

Our index of teachers' salaries, given in Table 6, is calculated analogously to the indices described in section four. It is derived from regression one of Table 1, with the proportion of teachers with a master's degree (PMA), the average years of experience (EXP), the proportion of teachers black (TCHBLK), and the proportion of teachers male (PMAL) considered to be demand variables. The others reflect supply phenomena. As in section four, all variables are weighted by the number of teachers in each county rather than by average daily attendance. Florida law recognizes that schools in areas with low population density have smaller classes and allocates funds accordingly. The number of teachers is not precisely the correct weight to apply, but any difference between the correctly weighted index and that in Table 7 is unlikely to be discernible.

The short table below lists the amounts of money which would have been reallocated in Florida in 1970 under the hypothesis that our index of teachers' salaries had been used in place of alternative indices. The alternatives considered are an equal number of dollars per teacher, Brazer's

TABLE 6: Florida Educational Inputs
Price Index for 1970

County	Teacher Salary Index	Secretarial Wage Index	Blue Collar Wage Index	Total Index
Dade	110.94	109.46	113.38	110.41
Broward	111.66	102.28	111.34	109.64
Orange	103.47	99.75	90.98	101.49
Collier	96.91	100.82	120.62	100.02
Pinellas	102.14	97.34	87.74	99.87
Polk	99.42	97.08	105.62	99.72
Palm Beach	97.99	103.92	100.70	99.25
Duval	96.26	107.32	106.91	99.17
Brevard	93.83	119.14	103.14	98.87
Hillsborough	97.69	98.65	102.92	98.47
St. Lucie	100.13	88.23	97.48	98.08
Seminole	98.32	96.40	88.01	97.09
Lee	96.56	94.79	100.89	96.90
Monroe	95.72	89.25	114.62	96.85
St. Johns	95.91	97.19	95.66	96.28
Indian River	96.13	94.73	97.34	96.24
Jefferson	92.95	109.43	93.43	95.82
Hendry	95.00	98.23	94.67	95.70
Martin	95.04	85.47	103.97	94.75
DeSoto	94.58	86.77	103.56	94.57
Hardee	92.46	87.40	114.84	94.31
Gadsden	94.76	96.69	83.75	94.21
Okeechobee	93.26	82.02	116.19	94.20
Sarasota	91.34	97.66	102.59	93.85
Baker	91.38	94.32	105.95	93.71
Hamilton	93.05	84.40	108.37	93.63
Volusia	94.29	92.72	86.88	93.60
Escambia	92.05	100.22	90.60	93.53
Dixie	92.10	89.90	105.46	93.50
Marion	94.18	85.73	96.79	93.46
Lake	96.02	85.62	83.23	93.38
Osceola	94.04	92.91	84.82	93.25
Gulf	88.57	104.11	105.29	93.14
Manatee	93.34	91.39	90.79	93.13
Glades	92.60	85.73	103.80	93.06
Charlotte	91.49	91.29	102.73	93.01
Paaco	94.11	88.10	88.20	92.92
Columbia	91.54	96.66	91.20	92.70
Hernando	95.05	70.06	102.73	92.32
Bradford	93.62	82.31	93.79	92.26

Table 6

County	Teacher Salary Index	Secretarial Wage Index	Blue Collar Wage Index	Total Index
Highlands	93.02	90.77	81.93	91.93
Liberty	85.60	103.95	113.93	91.91
Bay	89.32	95.36	99.43	91.77
Alachua	84.42	90.24	70.73	91.70
Washington	90.59	92.98	92.36	91.59
Levy	90.44	86.04	103.17	91.53
Sumter	92.44	83.25	92.36	91.43
Nassau	90.84	84.53	101.52	91.42
Suwanee	92.51	85.60	84.00	91.00
Clay	89.09	104.50	76.15	90.65
Jackson	90.10	89.25	91.29	90.59
Flagler	92.01	78.31	93.90	90.54
Leon	91.00	97.68	69.00	90.25
Taylor	89.61	89.51	90.76	90.23
Okaloosa	88.24	95.65	89.06	90.02
Putnam	92.00	84.00	77.01	89.70
Walton	90.54	80.09	91.59	89.55
Santa Rosa	88.08	95.28	83.89	89.34
Wakulla	87.31	105.25	70.62	88.97
Lafayette	87.43	82.52	98.41	88.42
Calhoun	85.20	85.78	107.93	88.30
Holmes	89.53	75.42	90.79	88.06
Franklin	92.62	68.65	64.41	86.57
Madison	89.78	64.69	79.21	85.47
Gilchrist	88.19	58.74	96.29	85.18
Citrus	87.52	62.21	76.76	83.27
Union	83.47	86.59	67.24	83.14

index by his interpretation, Brazer's index by our interpretation, and the Florida price level indices for 1972, 1973, and 1974.

Alternative	Millions of Dollars
Equal Amount	17.4
Brazer Demand (WIND)	18.6
Brazer Supply (SIND)	9.0
FPLI 1972	7.2
FPLI 1973	9.3
FPLI 1974	10.4

From this table one may see that, not surprisingly, the allocation of funds by our index differs noticeably from an equal distribution per teacher. Our salary index ranges from highs of 111.66 for Broward and 110.94 for Dade, both urban counties in southern Florida, to lows in the 80's for rural northern counties. Also not surprisingly, our index has an impact considerably at variance with the index based on Brazer's interpretation of his model. This result is expected since only the variables representing the perceived quality of teachers are classified on the demand side in our model. That is, in our model teacher quality variables are the only variables affecting teachers' salaries on which school districts are able to have any impact.

That our index would differ significantly from that based on Brazer's equation under the assumption that each district confronts a perfectly elastic supply of teachers' services was more doubtful. If counties could be described adquately with information locating them in a space of few dimensions -- degree of urbanization, per capita real income, and cost of living, for example -- then almost any set of several non-collinear and non-trivial variables selected from the vector of those available would result

in much the same index. But at least for Florida the choice of regressors does matter. Most of the difference between the two indices appears to be accounted for by the proportion of the population of recent foreign ancestry (PFOR) and the proportion of the population living in the same house as five years sgo (STAY) in Brazer's equation and by the price of agricultural land (AGND) and the incidence of aggravated assault (ASLT) in ours. Four-fifths of the reallocation from using our equation instead of Brazer's would involve funds taken from Dade, Palm Beach, and Sarasota snd given to Broward, Orange, Polk, and Duval counties. The main cities are Miami, West Palm Beach, and Sarasota in the first group of counties and Fort Lauderdale, Orlando, Lakeland, and Jacksonville in the second. The differentiation between the two groups results primarily from relative values of the four variables mentioned. Among other things, this difference shows the importance of finding out whether teachers require higher sslaries to work with Spanish-speaking students. As noted in section four, this would be difficult to determine with data from Florida alone.

Comparison of our index to the Florida price of living index (FPLI) is hindered by the fact that our index is for 1970 whereas the FPLI is first availsble for 1972. It is imposaible to know what portions of the differences given above are due to the lapse of time. Since the divergence grows from $7.2 million using the 1972 FPLI to $10.4 million using thst for 1974, even though both are standardized on 1970 expenditures, backward extrapolation suggests a 1970 difference of only four million dollars. But such extrspolation is hazardous, especially in view of the more rapid rates of change in relative prices in the abnormal 1972-74 period. No consistent pattern

emerges from comparison of the two indices. Presumably, the difference between them arises from the inclusion of amenity variables in regression one of Table 1.

The existence of the FPLI allows us to test the hypothesis that nominal salaries adjust, other things the same, to equate real wages across counties. If that happens, the percentage change in a nominal pay from one county to another should equal the percentage change in the price level index. A logarithmic regression of nominal salaries on the price index should yield a coefficient of one provided differences in amenities are either uncorrelated with the price index or else included as independent variables. We have performed a crude test, regressing the logarithm of wage measures on the logarithm of a form of the FPLI. The results, shown in Table 7, though weak evidence, do increase our confidence in the hypothesis that nominal salaries adjust. In no case does the coefficient differ significantly from one. [15]

Table 7 also shows the proportion of the variation in salaries explained by the FPLI to be thirty percent lower on average than that explained by the equations with similar dependent variables in Table 2. This points out the importance of incuding variables other than those representing the cost of living.

Teachers' salaries and administrative salaries closely related to those for teachers constitute approximately 70% of all non-construction expenditures on elementary and secondary education in Florida. From data in state budget studies we estimate that of the remaining 30%, half varies from local salaries for secretarial and clerical assistance, one-third with

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[15] An additional problem is that random errors in the index would bias the estimated coefficients toward zero.

TABLE 7: Teachers' Salaries and the FPLI

	1973		1974	
	LWG3	LWG2	LWG3	LWG2
CONSTANT	4.597	4.595	5.371	5.391
	(.763)	(.789)	(.724)	(.728)
LFPLF	.995	1.018	.861	.856
	(.167)	(.173)	(.159)	(.159)
n	31	31	50	50
R^2	.550	.544	.379	.374
SEE	.050	.052	.053	.053

NOTE: All variables are in natural logarithmic form, as indicated by the L in front of each. The Florida price level index was formed from five separate indices (food, .23619; health, recreation, and personal services, .20519; housing, .32852; apparel, .09825; and transportation, .13185) using geometric rather than arithmetic weights. Regressions using the published arithmetic FPLI yielded similar coefficients and slightly lower R^2's.

Those counties for which the FPLI was estimated by regression rather than by sampling of prices were excluded. These regressions were not repeated for 1972 because too few observations are available.

local blue-collar wages, and one-sixth with the prices of tradable goods, such as textbooks, which will be equal across counties.[16] The composite index and its components are in Table 6. The secretarial and blue collar wage indices are based on the same weighting as is the index of teachers' salaries.

Underlying the composite index is the supposition that schooling has a fixed-proportions production function; that is substituting one input such as books for another such as teachers is impossible. The particular function behind the composite index in Table 6 is

$$E_i = A \min (T_i/.70,\ U_i/.15,\ B_i/.10,\ M_i/.05), \qquad (4)$$

where for the i^{th} district E_i is the flow of schooling provided, T_i is teachers' services, U_i is secretarial work, B_i is blue-collar work, and M_i represents use of "imported" goods such as books. The units employed for measuring inputs are inversely proportional to the average prices of those inputs in Florida. The efficiency measure, A, is assumed invariant across counties. The denominators are the weights assigned the components in the arithmetic index and sum to one.

One might argue that substitution among inputs in possible, making the arithmetic weighting inappropriate. Knowing of no successful effort to estimate the ease with which educational inputs can replace each other, we tested the importance of this question for the purpose at hand by forming a geometric index, based on a Cobb-Douglas production function, which has unitary elasticity of substitution.

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[16] We did not form an index for construction costs, since all building projects in Florida are funded individually with resources controlled by a state board. Moreover, after adjustment for inflation, construction expenditures are declining over time.

$$E_i = AT_i^{.70} W_i^{.15} B_i^{.10} M_i^{.05}, \qquad (5)$$

where the value of A may differ from that in equation (4). The other variables are the same as before. This geometric index was found to differ insignificantly from the arithmetic index. Using one instead of the other results in the hypothetical reallocation of less than $200,000 in Florida in 1970. This figure is small primarily because teschers' salaries form a large portion of the composite index and secondarily because secretarial and blue collar wages are positively correlsted with those for teachers.[17]

With respect to construction of this index, then, the degree to which inputs can be substituted appears to matter little. What do matter are the variables selected for the regression equstion upon which the index is based and how those variables are interpreted.

VI. A CRITIQUE OF THE FLORIDA PRICE-OF-LIVING INDEX

Over four years, construction of the Florida price-of-living Index has required $1,295,500, broken down as follows:[18]

Year	Survey	Other	Total	Counties Surveyed	Items Priced
1972	82,000	155,500	237,500	12	110
1973	175,600	146,400	322,000	31	110
1974	210,000	244,000	454,000	50	144
1975	165,000	117,000	282,000	35	135

[17] The importance of this positive correlation should not be over-estimated. The R^2 between the indices for teachers' and secretaries' salaries is only 0.11, and between the indices for teachers' salaries and blue collar wages is only 0.12. The supply of teachers' services does not appear to be closely tied to conditions in local labor markets.

[18] Letter from Gary D. Cooper, director of the Cost-of-Living Study, July 28, 1975. The 1975 county and item totals are estimates.

These figures pale beside the resources spent on education in Florida, now about two billion dollars annually. Even when the comparison is limited to those funds whose destinations were changed as a result of the index, expenditures on its construction appear insignificant. The $454,000 spent in 1974 is less than three percent of the approximately twenty million dollars reallocated by it in the 1974-75 school year. Thus, more important than the cost of the index is the question of whether it serves as an appropriate criterion for the allocation of state funds.

Our opinion is that state educational expenditures should not be distributed in accordance with either a price-of-living or a price-of-educational-inputs index for reasons of both efficiency and equity. When states give more funds per pupil to districts where educational inputs are more expensive, families have less incentive to move to areas where education of a given quality can be obtained more cheaply. This drives up the cost of living and hence the cost of education; eventually these states will be able to purchase less real educational input per dollar.[19] Moreover, families who choose to live in areas where educational inputs are expensive or the cost of living high presumably do so because they receive higher incomes or enjoy other locational advantages in compensation. In Florida nine-tenths

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[19] This argument does not apply to compensation teachers might require for what they consider undesirable characteristics of students, since the students would retain these characteristics wherever they live. For this reason we do favor extra state funding for schools (not districts) whose pupils have low socio-economic status. To be distributed properly, this extra funding should be based on sound estimates of the salary differentials teachers demand to instruct low-status pupils.

of the impact of the cost-of-living index in 1974 was to raise state funding for the Miami area -- Dade, Broward, and Palm Beach counties -- where incomes, property values per pupil, and expenditures per pupil, all measured in real terms, are above state averages. The same would have been true if our index, derived from a compensating differentials approach,had been used. Whether this reallocation is equitable is a complex matter, but we see no obvious reason to believe it is.

Use of an annually revised index may also add to the uncertainty school districts face when planning expenditures.[20] There are two causes of year-to-year changes in the index to consider here, variations due to measurement error and variations in the actual cost of living. Presumably variations in funding due to measurement error would not be beneficial, while those caused by fluctuations in the relative cost of living would be, since counties with more rapid inflation would receive a larger fraction of the funds. But even in this latter case the net effect may be unsettling if prices tend to rise relatively in counties which enjoy prosperity and fall relatively in those which suffer recession. These latter counties, in addition to having to adjust to higher unemployment and falling real estate values, would receive lower state funding for education than they would have on the basis of the previous year's index.

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[20]The average absolute value of the change in the index for each county between 1973 and 1974 was 2.5 percentage points, or 54% of the standard deviation of the 1974 index.

More serious than the effect of annual fluctuations in the cost of living index are the problems of bias. As we have seen, in order to correctly compensate for differences in educational costs, variation both in the cost of living and in location-specific amenity levels must be taken into consideration. A system of compensation which is based solely on the cost of living will not adequately compensate those districts which are less desirable to live in. Also, across counties the most variable components of the Florida Price of Living Index are housing and apparel. These two categories, which together account for 83% of the variance of the index,[21] may be precisely the ones for which standardization for quality is most difficult. According to the 1974 index, clothing of a given quality is 35% more expensive in Collier County (site of Naples, a wintering spot for the well-to-do on the Gulf of Mexico) than in neighboring DeSoto County. If the index is correct, one should find teachers from Naples traveling to Arcadia (population 6,106), the capital of DeSoto, to purchase apparel. But one suspects the reverse happens more frequently, in view of the greater variety and higher quality of the clothing available in Naples. Nonetheless, citizens of Collier County, with a per capita income of $5,933 in 1973, solely because of the estimate that they pay higher prices for clothing, received three percent more per pupil in state funding in 1974-75 than

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[21] For 1974 we formed a new index for the fifty surveyed counties for which we hypothetically assumed that housing and apparel prices were the same in all counties. The variance of the index so constructed is 3.56, compared to 21.31 for the 1974 Florida price of living index.

citizens in DeSoto, with a per capita income of $3,726. On the basis of all estimated prices, those in Collier received 11% more per pupil. Consider another example. Is it likely that a teacher in wealthy West Palm Beach pays 23% more for clothing of a given quality than one in isolated Okeechobee (population 4,139)? Solely because of the supposition that he does, schools in West Palm Beach received two per cent more per pupil than those in Okeechobee, even though the latter county's per capita income is 45% lower. On the basis of all estimated prices, Palm Beach received nine per cent more. Apparently, despite efforts to control for quality, the index is biased upward in well-to-do counties because their stores stock better clothing, because people in them live in better houses and apartments, and perhaps because their health and other services are more nearly adequate.

The distributional implications of this bias, if it exists, are clear. Conceivably, it could be reduced through more adequate control for variations in quality. But some combinations of goods and services are comparable only through revealed preferences. That is, instead of trying to ascertain exactly what size apartment a block from the Atlantic is the equivalent of a three-bedroom frame house in a pecan grove, why not find out directly what salary differentials are required to attract teachers of a given quality to schools in the respective counties? The reply to this question might be that the perceived quality of teachers is also hard to define and standardize. The experience, education, sex, and race variables used in estimating compensating salary differentials are not fully adequate measures of perceived teacher quality. Moreover, some of the independent variables used in the compensating differentials regressions are not available annually.

This suggests that if the state should distribute funds in proportion to an index of the prices of educational inputs -- a presumption we do not share -- then the price-of-living index and compensating differentials approaches should be jointly employed. Our (conditional) recommendations then, are to:

(1.) continue the Florida price-of-living index. Since it should not serve as the entire basis for the allocation of funds, it could be derived from a less comprehensive survey in terms of both the number of items covered and the number of locations sampled separately. That the cost can be reduced without great loss of information is indicated by the statement in the 1974 survey report that 89% of the inter-county variation was accounted for by 35 items priced by personnel remaining in Tallahassee using telephone and mail surveys and government agency reports.[22] One drawback of relying more heavily on the centrally priced items should be noted, however: 57% of the weight of these items and perhaps even more of their variance comes from housing, for which quality standardization is especially problematical.

(2.) obtain further information about teacher quality variation among school districts. This could be done through coding data now stored in the Florida Department of Education and perhaps through undertaking additional surveys.

(3.) use estimates of required compensating differentials in salaries as the foundation for redistribution. These estimates should be revised

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[22] Florida Price Level Index, 1974, p. 3.

from year to year in view of the results of the price of living surveys and changing conditions in the market for teachers' services. These revisions should try to use the information contained in past surveys in an attempt to correct for sample errors.

VII. CONCLUSIONS

With a model of compensating differentials used to explain teachers' salaries in Florida's county school districts in 1970 we have found teachers of a given quality to receive higher salaries where the cost of living is higher. Teachers also require higher pay to work with less able students, to work in crime-ridden areas, or to work far from urban facilities. Lacking a cross-sectional price index for 1970, we have used the price of the only locationally immobile major input, land, as a measure of the local price level. The coefficients obtained suggest that a doubling of average land prices causes county prices to be about three percent higher.

The results show further that in Florida in 1970 male teachers earned more on average than females, those with master's degrees earned more than those without, those on continuing contract or with many years of experience earned more than those without tenure or with few years of experience, and whites earned more than blacks.

The model developed retains its high explanatory power when applied to data for Florida in 1960. In this application it was discovered that the relative salaries of female teachers rose while those of black teachers fell during the 1960's. Also the cross-sectional elasticity of county prices with respect to agricultural land values and the proportion of the population living in an urban area rose. During the decade prices rose more rapidly in cities than in rural areas.

As a means of comparing the market for teachers' services in Florida to that in another state, Harvey Brazer's equation for explaining cross-district salary differentials in Michigan was estimated for Florida in 1970. The coefficients obtained differ insignificantly from those for Michigan. The markets in the two states appear to be similar. Our interpretation of the model differs from Brazer's however, in that we think the coefficients of most of his demand variables actually represent the effects of shifts in supply. This difference in suppositions is found to have a significant impact when indices are based on Brazer's equation.

Also in the construction of an index, the form of the underlying production function turned out to be relatively unimportant, whereas the variables chosen and how they are interpreted matter a great deal. When the Florida price level index is used to explain cross-sectional variations in teachers' salaries, the regressions yield appropriate coefficients but explain a smaller proportion of the variance than the variables included in the compensating differentials model when applied to the same dependent variables.

While there are many possible ways to develop the work presented here, the most appropriate at this stage, we believe, is further testing and refinement of the model of compensating differentials through its application to data from other states.

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This paper is an abridged version of the final report submitted to the U.S. Office of Education. Copies of the unabridged paper may be obtained from Mrs. Esther O. Tron, U.S. Office of Education, Bureau of Elementary and Secondary Education, Washington, D.C. 20202.

APPENDIX A

Teacher Salary Equations - The Full Regressions

In this appendix we will report on regressions which included several variables which seemed to have no impact on teachers' wages in Florida. Tables A-1 and A-2 depict regressions which are similar to regressions in Table 1 and 2 respectively. Since the full regressions yield results which are very close to those reported for the shorter regressions in Tables 1 and 2, we will only discuss the differences between the full and short regressions. Generally, variables are slightly less significant in the full regressions than in the short regressions.

Let us first look at our measures of teacher quality. In the two stage regressions, the magnitude of the coefficients is greater here than in the short regressions. Moreover, the size of some of the coefficients seems unreasonable. Two additional measures of teacher quality are introduced in these regressions. We use the average test score of teachers with a B.A. and no experience (TCHTST) and the aversge grade point average of teachers with a B.A. and no experience (GPA) to attempt to measure variance in teacher quality, holding schooling and experience constant. The results are disappointing. The test score variable is positive in the B.A. regressions (9-11) and in the average wage regressions where EXP is used (1-4). GPA is positive only in the B.A. regressions. Neither variable is ever significant. Unfortunately we were only able to test this hypothesis with graduates from one school, the University of Florida; this probably limited the variance in teacher quality significantly. Furthermore, for more than forty counties we had to use estimated teacher quality, since University of Florida gradustes did not take jobs in these counties in the period for which we have data. Therefore the insignificance of our results may not be so surprising.

The job amenity variables both improve and worsen. TEST now is incorrectly positive in three regressions in Table A-1, and CLSSIZ is now more often positive and is twice significantly positive. The coefficients indicate that teachers demand over $100 more per year to teach one additional student. We introduce two new job amenity variables in these regressions. We expected that since junior high school teaching appears to be less desirable than other types of teaching that a greater salary would be demanded by those teaching it. However, JRHS consistently takes on the wrong sign. We also expected that because of discrimination teachers would demand more to work with black students. Here again the evidence is mixed, with BLAK taking on both positive and negative signs.

The price of living variables PURB and AGND are again significant and positive.

The location amenity variables perform similarly in both sets of tables. In the full regressions we introduce variables measuring the weather and access to recreational areas. Do teachers accept lower wages to work in a nicer climate? TEMP and PREC have mixed signs and varying significance. Perhaps this could be due to the small variance in weather in Florida. Finally only in the B.A. regressions do teachers require a greater salary to compensate them for being further away from the Atlantic Ocean (DAT) or from the Gulf of Mexico (GULF). These variables may be insignificant in most regressions because of off-setting effects. Living near the Atlantic or the Gulf is more desirable but also, as noted on page 39, more expensive.

A final hypothesis tested was the following: if schools have to hire additional teachers at an unusually rapid rate, because enrollment is rising unusually rapidly, they may find that they minimize hiring costs

Florida 1969-70 Extended Teacher Supply Regressions

TABLE A-1

	1 OLS Wage	2 2SLS Wage	3 OLS Awage	4 2SLS Awage	5 OLS Wage	6 2SLS Wage	7 OLS Awage	8 2SLS Awage
CONSTANT	7859.6** (3425.9)	6535.3 (5001.3)	11510.1** (3428.8)	9922.7* (5425.0)	8489.5** (3496.8)	8394.1* (4240.7)	11946.6* (3440.6)	12363.4** (4158.4)
PMA	4668.9** (1011.8)	5847.3** (2338.5)	4881.7** (1012.6)	6160.0** (2536.6)	4775.6** (1038.5)	6889.9** (2203.6)	4968.0** (1021.9)	7043.8** (2166.0)
EXP	179.59** (49.21)	302.88 (192.09)	145.30** (49.25)	319.88 (208.36)				
PC					2334.1** (711.7)	2637.4* (1367.3)	1938.6** (700.3)	2056.3 (1344.0)
DEV	-2.765 (7.663)	-1.063 (11.560)	-3.584 (7.640)	-3.335 (12.540)	.650 (7.842)	3.594 (11.022)	-.699 (7.716)	.240 (10.834)
DAT	-1.418 1.372	-2.883 (69.461)	-2.044 (27.196)	-3.216 (75.347)	-.610 (27.682)	-1.105 (64.463)	-1.388 (27.237)	-1.215 (63.363)
TEST	-7.812 (27.173)	20.097 (69.461)	-14.772 (27.196)	-20.340 (75.347)	.531 (27.682)	23.213 (64.463)	-8.159 (27.237)	-17.197 (63.363)
GULF	-2.748 (2.372)	-3.529 (3.379)	-3.514 (2.374)	-3.561 (3.666)	-2.743 (2.436)	-2.980 (3.097)	-3.516 (2.397)	-2.881 (3.044)
TCHBLK	-2975.1 (2035.6)	-9781.0 (6613.9)	-4629.9** (2037.4)	-12987.4* (7174.3)	-1487.0 (1958.0)	-5904.0 (4545.9)	-3481.7* (1926.5)	-7801.6* (4468.2)
CLSSIZ	123.53** (56.27)	295.78 (237.63)	132.77** (56.32)	371.16 (257.76)	51.039 (55.851)	92.911 (156.288)	72.359 (54.954)	138.02 (153.62)
DCC	5.629** (2.774)	5.360 (3.957)	5.398* (2.776)	4.873 (4.292)	5.514* (2.853)	5.527 (3.672)	5.270* (2.807)	5.051 (3.609)
PMAL	1547.0 (1231.0)	5181.0 (4718.6)	1725.4 (1232.1)	6512.5 (5118.4)	1817.3 (1289.6)	3756.3 (4031.3)	1996.0 (1268.9)	4466.6 (3962.4)
AGND	.946** (.226)	.949** (.317)	1.113** (.226)	1.110** (.344)	.849** (.236)	.881** (.300)	1.026** (.232)	1.073** (.295)
JRHS	-3890.6 (2974.8)	-8217.4 (8688.5)	-5018.6* (2977.4)	-11213 (9425)	-2822.6 (3047.9)	-2595.9 (6805.1)	-4128.4 (2998.9)	-4744.4 (6688.9)

TABLE A-1 (Cont'd)

	1 Wage	2 Wage	3 Awage	4 Awage	5 Wage	6 Wage	7 Awage	8 Awage
BLAK	386.00 (1296.84)	5013.6 (3841.1)	1565.2 (1298.0)	6722.0 (4166.6)	-324.56 (1287.50)	2772.4 (2680.0)	1013.9 (1266.8)	3747.5 (2634.3)
TCHTST	.870 (.813)	1.749 (1.896)	.412 (.813)	1.865 (2.056)	-.082 (.730)	-.118 (.961)	-.343 (.718)	-.304 (.945)
GPA	-121.05 (87.99)	-191.64 (170.33)	-52.610 (88.069)	-150.44 (184.76)	-90.901 (86.839)	-106.80 (126.89)	-30.122 (87.411)	-31.771 (124.72)
ASLT	1.4858** (.5176)	2.3337** (.9839)	1.4462** (.5180)	2.3480** (1.0673)	1.4949** (.5361)	2.0446** (.7558)	1.4742** (.5275)	1.8272** (.7626)
PURB	366.59 (357.18)	400.38 (591.71)	582.35 (357.49)	796.95 (641.84)	510.33 (371.82)	618.43 (552.16)	709.39* (365.85)	988.51* (542.73)
TEMP	-68.49 (50.02)	-142.36 (85.96)	-110.66** (50.07)	-184.81* (93.25)	-58.940 (51.539)	-105.67 (73.35)	-102.22** (50.71)	-140.70* (72.09)
PREC	.571 (.487)	1.146 (.963)	.275 (.487)	1.066 (1.045)	.548 (.504)	.716 (.711)	.281 (.496)	.430 (.699)
DEN	-.297 (.265)	-.546 (.402)	-.325 (.266)	-.626 (.437)	-.202 (.270)	-.316 (.323)	-.249 (.266)	-.355 (.317)
DEL	4688.5 (2976.2)	4325.1 (5316.4)	4376.5 (2978.8)	5630.5 (5766.9)	3086.1 (3079.8)	341.7 (4610.4)	3003.3 (3030.3)	1669.9 (4531.6)
R^2	.760	.619	.760	.553	.746	.672	.755	.684
SEE	390	491	390	532	400	455	394	448

Florida 1969-70 Extended Teacher Supply Regressions

TABLE A-2

	9 AWG3	10 AWN3N	11 AWN3X	12 AWG2	13 AWN2N	14 AWN2X
	5593.4** (2382.8)	6925.5** (1369.5)	4239.4 (3859.3)	9721.9** (3106.6)	11092.4** (2123.7)	8329.0* (4541.2)
	-6.919 (5.281)	-1.790 (3.035)	-12.131 (8.554)	-1.187 (6.843)	3.971 (4.678)	-6.429 (10.003)
DAT	.739 (.953)	.212 (.548)	1.276 (1.544)	-.752 (1.244)	-1.128 (.851)	-.369 (1.819)
TEST	-50.112** (19.085)	-32.511** (10.969)	-68.002** (30.911)	-35.957 (24.367)	-26.248 (16.657)	-45.825 (35.619)
GULF	1.043 (1.684)	.594 (.968)	1.499 (2.727)	-1.208 (2.202)	-1.244 (1.505)	-1.172 (3.219)
TCHBLK	-1306.5 (1289.5)	-967.63 (741.10)	-1650.9 (2088.5)	-1441.2 (1664.5)	-1554.5 (1137.8)	-1326.1 (2433.1)
CLSSIZ	-34.85 (37.17)	.279 (21.363)	-70.565 (60.202)	-31.303 (48.878)	9.824 (33.412)	-73.106 (71.449)
DCC	.002 (1.948)	1.758 (1.119)	-1.782 (3.155)	1.661 (2.452)	2.831* (1.676)	.471 (3.585)
PMAL	1519.0* (857.1)	880.14* (492.62)	2168.3 (1388.3)	918.64 (1113.87)	241.27 (761.43)	1607.1 (1628.2)
AGND	.600** (.159)	.325** (.091)	.881** (.257)	.696** (.209)	.443** (.143)	.954** (.306)
JRHS	-1200.2 (2099.2)	-1944.7 (1206.5)	-443.51 (3400.01)	-2396.9 (2687.0)	-3140.0* (1836.8)	-1641.6 (3927.8)
BLAK	-95.600 (875.021)	10.873 (502.904)	-203.84 (1417.25)	-84.026 (1102.90)	232.97 (753.93)	-406.24 (1612.19)

TABLE A-2 (Continued)

	9 AWG3	10 AWN3N	11 AWN3X	12 AWG2	13 AWN2N	14 AWN2X
TCHTST	.401 (.482)	.043 (.277)	.764 (.780)			
GPA	11.270 (59.654)	18.560 (34.285)	3.863 (96.620)			
ASLT	.57955 (.34936)	.42141** (.20079)	.74049 (.56585)	.57414 (.46154)	.39372 (.31550)	.75754 (.67467)
PURB	908.74** (250.12)	456.05** (143.75)	1368.8** (405.1)	881.17** (327.18)	390.03* (223.65)	1380.4** (478.3)
TEMP	61.843* (35.148)	9.296 (20.201)	115.25** (56.93)	15.175 (46.373)	-34.997 (31.700)	66.171 (67.786)
PREC	-.134 (.327)	.172 (.188)	-.445 (.530)	-.614 (.430)	-.355 (.294)	-.877 (.629)
DEN	-.250 (.186)	-.048 (.107)	-.456 (.302)	-.362 (.246)	-.064 (.168)	-.664* (.360)
DEL	1463.5 (2065.5)	-54.774 (1187.08)	3006.6 (3345.4)	3832.7 (2724.8)	781.97 (1862.63)	6933.5* (3983.0)
R^2	.751	.616	.760	.658	.430	.718
SEE	277	159	448	366	250	535

by offering wages above the market wage. This hypothesis is not confirmed empirically. DEV is frequently negative but is never significant.

APPENDIX B

A. Variable Definitions

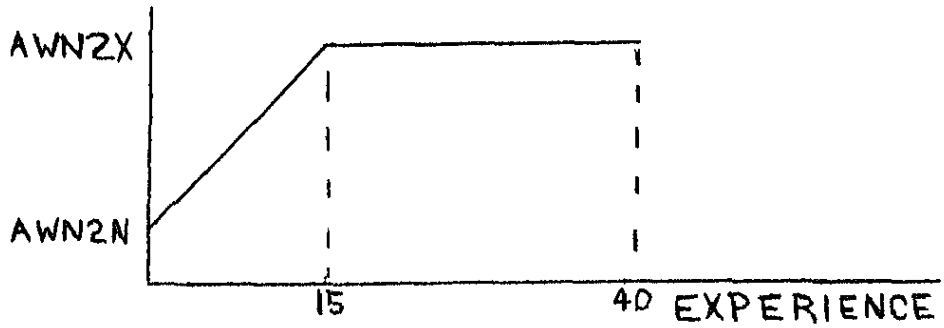
Unless specified otherwise, all variables refer to the period 1969-70; note also that 1% = .01. Figures in parenthesis are the mean and standard deviation of the variable respectively.

AGND: county value of land and buildings per acre in agriculture. (359.06, 374.47)

ASLT: number of aggravated assaults in 1971 per 100,000 people. (240.95, 127.49)

AWAGE: average instructional salary 1969-70 plus average instructional salary 1970-71 divided by two. (8285.6, 657.1)

AWG2:



postulate the above earnings profile for M.A.'s. Find its present value using a 10% discount rate. AWG2 is the constant wage rate over a forty year period that has the same present value. It is a measure of the average earnings of an M.A. over his lifetime. (8562.7, 540.0)

AWG3: similarly defined for B.A.'s. (7720.6, 468.4)

AWN2N: minimum salary for teachers with an M.A. (averaged over 69-70 and 70-71 school years). (10089, 869)

AWN2X: maximum salary for teachers with an M.A. (averaged over 69-70 and 70-71 school years). (10089, 869)

AWN3N: minimum salary for teachers with a B.A. (averaged over 69-70 and 70-71 school years). (6254.3, 216.6)

AWN3X: maximum salary for teachers with a B.A., (averaged over 69-70 and 70-71 school years). (9211.0, 771.7)

BLAK: percent of public school students in 74-75 who are black. (.22557, .13648)

CLSSIZ: average daily attendance divided by the number of full-time classroom teachers. (20.217, 1.703)

DAT: distance from county seat to Atlantic Ocean. (101.29, 86.93)

DCC: distance from county seat to central city of nearest SMSA. (39.824, 27.482)

DEL: number of juvenile arrests in 1971 divided by population. (.03277, .02913)

DEN: population density, number of people per square mile. (123.93, 270.71)

DEV: (rate of growth of students between 69-70 and 70-71 less average rate of growth of students between 59-60 and 69-70)/average rate of growth of students between 59-60 and 69-70. (-.93235, 7.50000)

EXP: average years of teaching experience 73-74. (9.3618, 1.7062)

GPA: average grade point average of Univeraity of Florida graduates with B.A.'s taking a first teaching job in that county in 70-71 or 71-72. If no University of Florida graduate took a job in a county in these years, a predicted GPA was used for that county. (3.1943, .64248)

GULF: distance to Gulf of Mexico from county aeat. (52.588, 38.853)

JRHS: percent of teachers teaching junior high school. (.24713, .02877)

PC: percent of instructional poaitions on continuing contract. Continuing contract is generally awarded after three to four years of continuous probationary service in a school district. (.51700, .09927)

PMA: percent of instructional positions filled by persons holding at least an M.A. (.25162, .06102)

PMAL: percent of regular full time teachers who were men. (.30182, .05666)

PREC: total inches of regional rainfall in 1973. (78.042, 120.263)

PURB: percent of population urban. (.42833, .30778)

TCHBLK: percent of teachers in 74-75 who were black. (.15755, .09949)

TCHTST: average Florida 12th grade test score of University of Florida graduates with B.A.'s taking a first teaching job in that county in 70-71 or 71-72. If no University of Florida graduate took a job in a county in these years, a predicted test score was used for that county. (345.81, 92.274)

TEMP: average January 1974 temperature in county. (68.791, 2.635)

TEST: district mean raw score in 12th grade aptitude test. (48.265, 4.266)

WAGE: average salary paid instructional staff. (8089.3, 656.2)

B. Variable Sources

Florida, Uniform Crime Reports, 1971: ASLT.

Florida, Commissioner of Education, Pupil, Personnel, and Financial Data, District School System, report for 1971-72: JRHS

Florida, Department of Education, Bureau of Research, Division of Elementary and Secondary Education.
1. Research Report 80: PC, PMA.
2. Research Report 90: AWAGE, CLSSIZ, DEV, PMAL, WAGE
3. Research Report 114: AWAGE, DEL
4. Research Report 117: BLAK, TCHBLK

Florida, Dapartment of Education files, AWG2, AWG3, AWN2N, AWN2X, AWN3N, AWN3X, EXP.

Florida, Department of Education, Profiles of Florida School Districts, Profiles II: CLSSIZ, TEST

Rand McNally map of Florida: DAT, DCC, GULF.

U.S. Bureau of the Census, City and County Data Book, 1972: AGND.

U.S. Bureau of the Census, 1970: DEN, PURB.

U.S. Department of Commerce, Climatological Data: PREC, TEMP

University of Florida, Registrar's records: GPA, TCHTST.

APPENDIX C

To estimate the two stage least squares regressions detailed in Table 1, a model specifying how school inputs are chosen is required.[1] Parents are postulated to have a preference function with the outcome of the educational process (let us call it child quality) as one element. That is, parents are better off having a child who knows much than having a child who knows little, other things equal. Child quality is produced in an educational production function with parental time inputs, non-school goods inputs, and various school inputs. The amount of child quality demanded will be a function of family non-wage income, the husband's wage, the wife's wage, the husband's efficiency in producing child quality and other commodities, the wife's efficiency in producing child quality and other commodities, whether the marriage has dissolved, the relative prices of various school inputs, and the relative prices of other goods. Similarly, the quantity of school inputs (i.e., teacher quality, class size, etc.) demanded will also be a function of the above variables. Thus, following the model we just developed, the following variables were considered to be instrumental variables (i.e., variables exogenous to the system) in the two stage least squares (2 SLS) regressions in Table 1: average family "other" income, average full-year earnings of males 16 and older and with earnings, average full-year earnings of females 16 and older and with earnings, median years of school completed by persons 25 and older, percent of currently married, widowed or divorced population 14 years of age and older which is divorced, percent of currently married, widowed or divorced population 14 and older which is widowed, average

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[1] This discussion is necessarily brief. See Lawrence W. Kenny, "Demands for Child Quality and for Educational Inputs, The Production of Child Quality, and Related Topics," Dissertation in progress, University of Chicago.

number of children ever born to women 35-44, and state equalized property valuation per pupil (to adjust for constraints imposed by Florida's system for the reallocation of educational funds). To measure other relative prices and demand shifters, we also considered the following variables to be instruments: DEV, DAT, GULF, DCC, AGND, BLAK, ASLT, PURB, TEMP, and PREC. All these variables were then used to estimate the remaining endogenous variables in Table 1.